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OPINION TOWARD EDUCATION IN MONTREAL, CANADA

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Chapter I

Introduction and Statement of the Problem

Good educational administration and supervision must be directed to the social and educational thinking of the community in which the school is located. Most school administrators and teachers realize the strong influence of public opinion upon the curriculum, organization and administration, and financial support of the schools. They are well aware of the necessity of good publicity through contacts with children, parent-teachers associations, radio, newspapers and other means of communication, but seldom is a technique employed to determine the exact attitudes of the public toward the schools.

Lippman in writing on the subject of public opinion in 1922 observed that:

> Since Public Opinion is supposed to be the prime mover in democracies, one might reasonably expect to find a vast literature. One does not find it. There are excellent books on government and parties, that is, on the machinery which in theory registers public opinion after they are formed. But on the sources from which these public opinions arise, on the processes by which they are derived, there is relatively little. The existence of a force called Public Opinion is in the main taken for granted, and American political writers have been most interested either in the finding out how to make government express the common will, or in how to prevent the common will from subverting the purposes for which they believe the government exists. According to their traditions they have wished either to tame opinion or to obey it.[1]

Since 1922 there has developed a vast literature in the field of public opinion measurement as it is directed toward social and political questions, government policies and administration, market and product research. There have been relatively few attempts to systematically study opinions of the lay public toward controversial questions in the field of education.

Industrial organizations are interested in obtaining a continuous barometer of consumer opinion toward their particular product. Several government departments and bureaus such as the State Department and the Department of Agriculture[2] are interested in obtaining the opinion of the public toward proposed administrative policies. In a sense, these departments are attempting to pre-test the public's reaction before a policy or program is started. Executive officers try to get complete information regarding present attitudes of the public toward a proposed program or administrative action and then direct educational publicity toward the achievement of those goals.

The question as to how far the schools should go in conducting public opinion polls and directing subsequent education publicity in order to achieve a more favorable public opinion toward a particular educational goal to be achieved is raised by Rope as follows:

> "To what extent techniques of opinion research should be employed in a public school system is a problem for educational leadership to decide, although the emphasis which progressive administrators have placed upon the importance of strengthening the democratic process through sharing of decisions

* The author is particularly indebted to Dr. John Guy Fowlkes for initiating the study in this field of research, and to Dr. A. S. Barr, without whose constant guidance and generous help it could not have been completed; also to Dr. J. S. A. Bois, Dr. George Fergerson, and Dr. Gerard L. Barbeau of Montreal, who assisted in the wording of the questions and in determining the cross-section sample to be studied.

[1] Walter Lippman. *Public Opinion* (New York: MacMillan Co., 1922), pp. 486.

[2] Hans E. Skott. "Attitude Research in the Department of Agriculture," *Public Opinion Quarterly*, II (1943).

implies a willingness to utilize procedures that promise a realization of such an objective. Aside from providing increased opportunity for public participation in policy formation, the methods of opinion study offer direct information concerning the comparative influence of groups opposing and groups supporting the general work of the schools. In a sense, research in community attitudes serves the purpose of reconnoitering unknown territory."[3]

Conscientious teachers and administrators have always been alert to public opinion as it is related to the school. The usual practice has been to listen more attentively to those individuals and organizations that are important in the community. Seldom is a technique employed which reflects the opinion of the large unorganized majority in the community. More often, well organized vocal minorities are able to bring about educational changes merely because they are militant for a program which they wish to achieve.

Miller sees possibilities of utilizing public opinion measurement techniques that use cross-section methods of sampling as a tool to be used by teachers and administrators in determining problems related to school support, curriculum content, methods of instruction, organization and administration of education. He states:

"School administrators and teachers began to see the advisability of parallel lines of approach by the schools in their programs for obtaining the moral and financial support of communities. Out of their vision has come the increased utilization in recent years of community surveys to determine the basic needs that schools must serve. Out of it has come, too, the development of the cross-section poll as a means of discovering actual and potential school support. Because educators becoming increasingly aware of the possibility inherent in public opinion polls for the maintenance of increased school support and for the improvement of education, it is well to keep in mind the advantages as well as the disadvantages of the poll technique."[4]

The National Opinion Research Center, Denver University, which is financed by the Field Foundation, conducted a nationwide poll on the atitudes of the lay public toward education. It found:

"54 per cent think the public schools need more money to do a good job.
58 per cent believe that teachers are paid too little for the job they are expected to do.
68 per cent think that public school systems should be mostly controlled by the state rather than the federal government.
69 per cent favor having the federal government turn over a certain amount of money to the states every year for their schools."[5]

The Canadian Institute of Public Opinion in March, 1945, asked the following question on a nationwide poll:

"At the present time, most public schools and high schools in Canada are run by the various provincial governments. Do you think this should be continued, or should all these schools be run by the federal government in Ottawa?"[6]

Provincial control	53 per cent
Federal control	34 per cent
Undecided	13 per cent

	Ontario	Quebec
Provincial	49 per cent	69 per cent
Federal	35 per cent	18 per cent
Undecided	16 per cent	13 per cent

Van Patten sees much wider use of the technique of public opinion measurement as applied to solving educational problems. She states:

"One of the clearest examples of how public opinion research may be of service to educators is an analysis of what laymen think about the field of education itself. People in the United States are interested in education. Do educators know what the public thinks? Public opinion research is a tool available to educators as well as to businessmen and government officials. Only a beginning has been made in revealing attitudes regarding educational problems."[7]

There does not exist complete agreement of opinion as to the value of polls in solving social and economic problems. Bernays in his criticism of polls entitled *"Attitude Polls—*

[3] Frederick T. Rope, *Opinion Conflict and School Support* (New York: Teachers College, Columbia University, 1941), pp. 142.
[4] Clyde R. Miller. "Public Opinion Polls and Public Schools," *Teachers College Record* (Jan., 1942), p. 248.
[5] Louise M. Van Patten. "The Public Think Aloud," *The Educational Forum* (May, 1945), p. 447.
[6] "The Quarter's Polls, "*Public Opinion Quarterly*, II (1945), p. 236.
[7] Van Patten, Louise M. *op. cit.*, p. 248.

Servants or Masters" states:

"There is too liberal an acceptance of the validity of attitude polls. Many people believe that, when a poll shows 51 per cent of the public favoring a proposition, that is the will of the public.

There is, too, the danger in the new kind of leadership which polls have produced in the United States—leadership of obedience to polls. Correct polls must be carefully used:

1. Because attitude polls exercise so strong an influence upon the public as often to discourage use of sound democratic methods of reaching important decisions.
2. Because society suffers when polls inhibit leaders from independent thinking, from anticipating change or from preparing the public for change.
3. Because polls exert pressure that may place society under what Jefferson called the tyranny of the majority and throttle progressive minority ideas."[8]

McGuire, in an address delivered at the Annual Meeting of the Virginia State Bar Association on August 4, 1939, makes the following attack on public opinion polls. He states:

"The straw ballot is undermining our Republican form of government and tending to substitute a direct or pure democracy, which has never succeeded in the history of the world in a community of any considerable size, even remotely approaching the area and population of the United States. I remind you that the newspapers are financing this new attack on representative government in America through their subscriptions to these various straw polls."[9]

There have been many able statements made showing the value of attitude polls as a method of research for studying social, economic, and political questions. Many excellent statements could be quoted regarding how this technique of social research has helped in making democratic processes more responsive to the will of the people. In the following statement by Katz he states:

"Public opinion polls should be evaluated in a discriminating fashion. They are not going to revolutionize social science, but neither will they be a negligible instrument for social science. It is common to reject a method because it does not give us all the answers. There has hardly been a mathematical tool or methodological instrument devised for social or psychological research which has not drawn criticism because it could not give the whole story. It is similar with polls. They have definite limitations but are a valuable asset to students of society. They are not adequate to explore all the problems in public opinion and social psychology. No single instrument is. They are most adequate in measuring affects toward social symbols and they have made their greatest contribution in that field. In the areas of opinions and attitudes they are decidedly useful, but here they must be interpreted with the greatest caution and supplemented whenever possible by other methods."[10]

[8] Barnays, Edward L. "Attituded Polls—Servants or Masters," *Public Opinion Quarterly*, III (1945), p. 266.

[9] McGuire, O. R. *The Republican Form of Government and the Straw Ballot—An Examination*, Address Delivered Annual Meeting of the Virginia State Bar Association, August 4, 1939, Richmond Press, Inc., Richmond, Va., p. 18.

[10] Katz, Daniel, "Three Criteria: Knowledge, Conviction, and Significance," *Public Opinion Quarterly*, IV (1940), p. 284.

The Problem and Its Scope

Need for the Study

Most of the schools in the Province of Quebec are parochial. The Protestant and Catholic Schools are continually facing problems which threaten their continuation. During May of 1945, the teachers of the Protestant Schools were refused contracts because of the Board's lack of financial ability. About two weeks before the opening of the schools in September, the provincial government gave the Protestant School Board a grant to continue to operate during the coming year.

In the greater Montreal district, one finds a meeting of French and English cultures. The problem of measuring lay attitudes towards education in Montreal has not been undertaken. An attempt to determine the educational thinking of the lay public could assist in helping to solve some of the educational problems and bring about greater understanding among the diversified races and religions in this area.

The Problem

The main purpose of this study is to determine lay attitudes toward education in Montreal for the population as a whole, and to discover if there is a relationship between opinions and certain background factors; namely, sex, language, age, religion, social status, and edu-

cation. The emphasis is placed on the general objectives of education to ascertain what type of school experiences parents wish their children to have.

The problem is limited to the measuring of atttitudes without attempting to evaluate the origin or merits of these attitudes, nor to classify them as desirable or undesirable, liberal or conservative.

This investigation will attempt to answer the following questions:

1. Does the lay public desire an increased emphasis placed on the study of national and international problems?
2. Do citizens desire an extension of educational services such as: increased health and medical services, increased intra-curricular activities, increased industrial training, and increased vocational guidance?
3. Does the lay public desire new and modern school buildings?
4. What are the attitudes toward religious education in the schools?
5. What are opinions concerning experimentation in education, provincial support, adjusting the curriculum to meet individual needs, teachers' salaries, expression of minority opinions, and physical punishment?
6. How do the opinions of men and women differ on educational questions?
7. How do respondents of different age groups differ on educational questions?
8. How do respondents of different languages differ on educational questions?
9. How do respondents of different religions differ on educational questions?
10. How do respondents of different levels of social status differ on educational questions?
11. How do respondents with different levels of education differ on educational questions?

The data gathering instrument consisted of a ballot having 22 items covering educational questions. Bilingual interviewers made contact with respondents in their homes to have a representative cross-section of Montreal opinion towards educational questions. Further discussion of the ballot and the method of conducting the investigation is discussed in chapter three.

Chapter II

Research in Public Opinion and Attitude Measurement

The research in public opinion measurement has grown rapidly since 1936. Many persons will recall it was in that year the famous Literary Digest was at error on a national election by 19 per cent. Since that time all polling organizations, in order to stay in business, have had to become more scientific in their approach to the many problems in the field of measuring public opinion.

Definition of Terms for Attitude Measurement

Public opinion measurement is part of the larger field of attitude measurement. Much research on attitude measurement preceded the popularity of polls. Research by Allport, Droba, Watson, Thurstone, Lickert and many others laid much of the theoretical basis in attitude measurement from which public opinion techniques have been developed. There are a great many researches in the field of attitude measurement. The literature will not be reviewed in this study other than a brief summary of the work of Thurstone and Lickert. The *Dictionary of Educaion* defines attitude and public opinion as follows:

> "Attitude: a state of mental or emotional readiness to react to situations, persons, or things in a manner in harmony with a habitual pattern of response previously conditioned to or associated with these stimuli.
>
> Attitude, social: the positive or negative mental set of a person or group with respect to a social object or phenomenon such as a person, race, institution or trait.
>
> Attitude, specific: an attitude toward a narrowly defined, relatively concrete attitude object such as labor unions, the school, or a teacher."[1]

[1] Good, Carter V., *Dictionary of Education* (New York: McGraw-Hill Book Co., 1945), p. 37.

"Public opinion: the average judgments or consensus of the individuals of a society regarding certain social problems or objects."[2]

Albig in his book *Public Opinion* defines attitude and public opinion as follows:

"Attitude as used in contemporary sociology or social psychology has a wide variety of meanings. These range from a temporary set of the organism, or Aufgabe, to a relatively permanent and complex tendencies to act, such as one's attitude toward war."[3]

"Attitudes are not units but complexes of other attitudes. As such they are general tendencies to modes of responses, not to particular responses. When an overt expression on a controversial point appears, we have an opinion."[4]

"Our position is that opinion is any expression on a controversial topic. Public opinion results from the interaction of persons one upon another in any group. The opinion process occurs in groups varying in size from two to the largest number ever responding to a common stimulus on a controversial issue."[5]

Cherif and Cantril, in their discussion of attitudes as a set for or against something, or a state of readiness to react in a certain way, have found five criteria which characterize attitudes. They are:

1. Attitudes always imply a subject-object relationship.
2. This means that attitudes are formed in relation of objects, persons, and values which may or may not have motivation appeal at first.
3. Attitudes have affective properties of varying degrees.
4. Attitudes are more or less enduring state of readiness.
5. Attitudes range in number and variety of stimuli to which they have referred.[6]

Two of the most commonly used methods for constructing attitude scales were developed by Thurstone and Chaves[7], and by Murphy and Lickert[8]. Briefly, the Thurstone technique is as follows: Several hundred statements of attitudes on one particular subject are printed on separate cards. A number of judges are to rank these cards on a psychological continuum from extreme affirmation to extreme negation. Those items are selected on which opinions of the judges vary least, and those items eliminated on which judges agree very little.

This procedure is time consuming, in addition to the difficulty of securing a competent number of judges. Likewise, each test or scale can measure attitudes toward only one question at a time, such as religion, communism, war, race or other social problems.

Murphy and Lickert, in their attitude study of *Public Opinion and the Individual,* treated their data according to two different statistical techniques. It was found that, by presenting an item which had five possible responses from the most favorable to the least favorable, employing of judges as used by Thurstone was unnecessary. They found further that by assigning simple weights on the five point scale, a value of one representing the most favorable response and five representing the least favorable response, this procedure correlated highly with the more difficult Thurstone technique. They found a correlation of .92 between a 5 point scale and a 3 point scale. In comparing their method of scoring and constructing an attitude scale with that of Thurstone's they state:

"Another decided advantage of the sigma technique is that it yields reliabilities as high as those obtained by other techniques with fewer items. Although the sigma technique seemed to be quite satisfactory for intended use, it was decided to try a similar technique. The simpler technique involved the assignment of values from 1 to 5 for each one of five different factors."[9]

They tried 3 different methods of scoring a three point scale and the results were all comparable. First, they assigned values of 2, 3, and 4, the middle value being the "no opinion" response. Second, they assigned values of 1, 3, and 5, the 3 being the "no opinion," and third they assigned plus; "no opinion" and minus to their data. The 3 point scale they concluded was as satisfactory, easier to administer, and more quickly tabulated. Other studies by Bardwell, Eye, Rope, Strong and others have used the three point scale for attitude measurement.

Problems in Public Opinion Measurement

Polls make their most dramatic appeal to the public during election campaigns. The litera-

[2] Good, Carter V., *op. cit.*, p. 320.
[3] Albig, William, *Public Opinion* (New York: McGraw-Hill Book Co., 1939), p. 174.
[4] Albig, William, *op. cit.*, p. 179.
[5] Albig, William, *op. cit.*, p. 3.
[6] Sherif, Muzafer and Cantril, Hadley. *The Psychology of Attitudes,* Psychological Review, November 1945, pp. 301-302.
[7] Thurstone, L. L., and Chave, E. J. *The Measurement of Attitudes,* University of Chicago Press, 1929.
[8] Murphy, Gardner and Lickert, Rensis. *Public Opinion and the Individual,* Harper Bros., New York, 1938.
[9] Murphy, Gardner and Lickert, Rensis, *op. cit.*, p. 44.

ture in public opinion has many references to polls and their accuracy in predicting elections. Gallup states:

> "Elections, then, are the laboratory in which the polls are tested, and which new facts and problems continually come to light. But the practical value of the polls lies in the fact that they indicate the main trends of sentiment on issues about which elections often tell us nothing."[10]

The accuracy of public opinion attitude polls when tested against election results is well illustrated in the following statement by Lydgate:

> "The Fortune survey has, since inception, predicted the outcome of two Presidential elections (1936 and 1940), and its error nationally was within 1 per cent. In 1940 the Crossley poll, giving specific figures for nineteen states, had an average state-by-state error of 2.7 per cent. The Gallup Poll has, up to the time of this writing, made 114 pre-election surveys since it was founded in 1935. Nineteen of the 114 elections were either forecast perfectly or with an error 1 per cent or less, 39 with an error of 2 per cent or 3 per cent, or a total of 58 with an error of less than 3 per cent, 31 were between 3 per cent and 6 per cent; 19 were between 6 per cent and 10 per cent; 6 were between 10 per cent and 15 per cent."[11]

One of the more important problems in this field is the question of sampling. The Literary Digest has well worded questions, and adequate size sample, but it did not have a representative sample. It failed to measure all strata of our society, resulting in error in its election prediction.

There are several criteria that determine sample design. A completely random sample should allow all persons the same opportunity to be selected in the sample. Second, a sample should be designed to give the maximum information with high reliability at a minimum of cost. Third, the sample should yield results that are susceptible to statistical treatment. Fourth, the sample is adequate if an increased number of interviews fails to bring about significant change in results.

Walker makes the following criticism of many of the samples studied in research:

> "Far too much published research is based upon cases chosen because they come conveniently to hand rather than upon cases chosen carefully as a random sample of the universe to which generalization is made. Most readers will need to read only one or two issues of a professional periodical before coming on a study in which the author makes generalizations which are so phrased as to refer to a universe from which his cases could not possibly be considered to be random sample."[12]

Most national polling organizations attempt to obtain a representative sample, which is a miniature of the universe to be sampled, by getting the proper proportion of ballots according to background factors or "controls." These proportions should be approximately the same as one finds in the census or social service information for a region or city. Some of these factors that can be controlled directly in getting a representative sample are proper sectional distribution, rural-urban distribution, sex, and color. It is frequently assumed that, if these variables are in the same proportion as census information, then, according to the principle of random sampling, other factors such as religion, national origin, education, and occupation will be in the proper proportions.

Completely random sampling is difficult to achieve and will not yield results as reliable per dollars spent as will representative sampling.

Wilks, in his article on sampling states:

> "Representative sampling as practiced in scientific polling and in many large scale surveys is a practical device for overcoming the difficulties which arise in trying to get a purely random sample from a given population."[13]

Wilks explains the commonly used procedure in conducting large scale surveys. He states:

> "In the case of United States national public opinion polls such as the Crossley, Gallup, and Fortune Polls, it has been found that it is sufficient for practical purposes to make the sample (1) representative with respect to several major U. S. Geographical or census districts, (2) representative with respect to a group of several city sizes and rural population within each district, (3) representative with respect to age, sex, color and economic status for each population's subgroup under two."[14]

[10] Gallup, George and Rae, S. F. *The Pulse of Democracy* (New York: Simon and Schuster, 1940), p. 90.
[11] Lydgate, William A. *What America Thinks* (New York: Thomas Y. Crowell Co., 1944), p. 148.
[12] Walker, Helen M., *Elementary Statistical Methods* (New York: Henry Holt and Company, 1943), p. 269.
[13] Wilks, S. S., "Confidence Limits and Critical Difference Between Percentages," *Public Opinion Quarterly*, IV (1940), p. 268.
[14] Wilks, S. S., *op. cit.*, p. 263.

Market research and national polling organizations use somewhat different background factors or "controls." Most of the research on sampling is published in scientific journals interested in this problem, but some research that is being carried on by private polling agencies and market research organizations is being withheld from publication because it constitutes a trade secret.

With respect to sampling, Lydgate writes:

"Poll-takers differ somewhat in their choice of statistical keys for 'controls' to assure a good cross-section. But the following are probably the most essential: The sample must contain the proper proportion of (1) people from each state, (2) people from upper, middle and lower economic groups, (3) men and women, (4) farmers and residents of small towns, medium-size cities and big cities, (5) adults of all age groups, and (6) Democrats, Republicans, and members of other political parties."[15]

The representative sample secured through stratified sampling procedures is in sharp contrast to polls conducted by some newspapers that request the reader to cut out the ballot and send it in to the newspaper, or by having a ballot that is sent out through the mail. Most of these other mass techniques which fail to send an interviewer to the residence of the respondents tend to develop some type of selective device which fails to get a true miniature of the population to be sampled. Unless a person is interviewed, the information received from background factors might not truly represent the respondent. Information obtained in this manner tends to reflect the thinking of the upper income groups in too great a proportion. It is also very difficult to get exact information as to the person's correct age, education and social status, because these factors have prestige value. Studies in this field as stated by Cantril show that respondents in the low average and poor groups consider themselves in the average or middle group. Thus, without an interviewer or some other objective criteria such as area sampling, it is difficult to determine a respondent's social or economic status.

Area sampling has been used extensively in order to eliminate interviewer errors in selecting and rating respondents in various economic classes. In the article by Hansen and Hauser, they briefly illustrate area sampling as follows:

"Area sampling eliminates dependence on the assignment of quotas that may be more or less seriously in error, and does not permit discretion in the choice of the individuals to be included in the sample. Suppose, for illustration, that we wish to draw a sample out of a universe of five blocks, and that everyone living in the selected blocks will be interviewed."[16]

This technique was used by Lazarfeld, Berelson and Gaudet, in their study of the 1940 election.[17] Erie County, Ohio, was selected as the area to be studied. Intensive study of this area, because of its previous voting record and proper breakdown according to controls, made it possible to do a detailed analysis of opinion conflict during an election campaign. Benson, Young and Syze, in their discussion of sampling, state:

"In addition to improving techniques now in use, polling organizations will naturally be interested in any different sampling system which will more nearly approach purely random and as a consequence will diminish dependence upon the interviewer for respondent selection—notably the area sampling system used by the Bureau of Census."[18]

The factors of cost are important in public opinion measurement. The following procedure would be too expensive for a private agency in conducting public opinion measurement. Keyfits, in his discussion of the procedure used by the Dominion Government to obtain quarterly reports on the labor force and unemployment in Canada, writes as follows:

"The application of these principles to the selection of 1 per cent of the households of Canada as a sample for the proposed quarterly estimate of the labour force is of interest because, on a wide variety of topics in the period of re-establishment and afterwards, the survey will provide immediate results with specifiable accuracy sufficient for administrative requirements.

We first separate the country into main regions in each of which the sample will be independently selected, and for each of which it is hoped to make estimates for the main

[15] Lydgate, William A., *op. cit.*, p. 137.

[16] Hansen, Morris H., and Hauser, Philip M. "Area Sampling—Some Principles of Sample Design," *Public Opinion Quarterly*, II (1945), p. 191.

[17] Lazarfeld Paul F., Berelson, B., and Gaudet, H., *The People's Choice* (New York: Duell, Sloan and Pearce, 1944).

[18] Benson, Edward C., Young, Cyrus C., and Syze, Clyde A. "Polling Lessons from the 1944 Elections," *Public Opinion Quarterly*, IV (1945), p. 484.

items. Then we set up each of the largest cities along with its metropolitan area as a separate stratum, in all of which we propose to sample. Within these cities we divide the entire area into segments each containing, as near as the information available in the office can tell us, 5 dwellings. We choose every hundredth such segment to constitute the sample."[19]

The problem of getting a representative sample is one of the most important in the field of public opinion measurement. It is even more important than the size of the sample. If the sample is properly stratified and represents all segments of the population in the proper proportion, polling organizations find that from 1,500 to 5,000 interfviews for a nationwide sample is sufficient. Lydgate points out that the principles of sampling for public opinion measurement is similar to the research methodology employed in other sciences such as medicine, engineering, education, and social science. He states:

"The Department of Agriculture has since the eighteen-sixties made advance estimates of crop yields by examining typical rows of wheat, corn, oats, cotton, etc., in representative farm areas. The poll-takers have merely applied these same principles of sampling to the public opinion field."[20]

Size of Sample

The question is often raised as to how large a sample must be in order to give reliable results. It should be large enough so that increased number of interviews would not change the results. If a representative sample is obtained at various stages of the interviewing procedure, the results will rapidly reach a plateau where further interviews do not significantly change the results.

There have been several controlled experiments showing the high validity obtainable with the small sample technique. Cantril reports the result of an experiment using small samples. A plebiscite was held in Canada on the question of conscription on April 27, 1942, in which 107 cases were obtained for Quebec and 101 cases for Ontario. He states:

"The two interviewers selected used their own ingenuity in starting conversations that would lead up to the conscription issue of the plebiscite. The man who interviewed in Ontario used two approaches, depending upon whether he was working in the city or in the country. In the cities he merely told people that he was a student in an American university, was interested in Canada and the war, and was wondering what people in Canada were thinking about the war in general. Eventually he brought the conversation around to the assignment. In rural areas he frequently told farmers that he thought a relative of his had once lived in that area and he wondered if they had ever known a family by the name of 'Hinshaw.' No farmer ever knew. But many suggested that an old-timer down the road might know. The young woman who interviewed in Quebec and who spoke French fluently said she had recently come from France, was just traveling around Canada, etc."[21]

The results of this sample were within 4.5 per cent of election returns for the Dominion of Canada, 4 per cent for Quebec, and 4 per cent for Ontario.

Gallup reports[22] a study by Cantril in which a single interviewer conducted 200 interviews in the state of New York before the 1942 gubernatorial election with an error of less than 3.5 per cent for all candidates.

Small samples have proven to be surprisingly accurate when their results have been checked against national polls or against election returns. However, where there are differences in opinion in geographic areas, small sample studies are subject to large error. No investigator would feel safe in predicting the outcome of an election or for a commercial client on the basis of very small samples. With a very limited number of cases, an investigator cannot get reliable breakdowns or other detailed information, nor can unexpected or unexplored differences of opinion be studied.

Directed Versus Non-directed Interviews

In the field of attitude measurement a controversy exists as to the merits of the non-directive or "open-ended" interview versus the formal type of questions as it appears on a ballot.

[19] Keyfitz, Nathan, "A Sampling Approach to Economic Data," *Canadian Journal of Economics and Political Science*, (August, 1945), p. 474.
[20] Lydgate, William, *op. cit.*, p. 136.
[21] Cantril, Hadley, *Gauging Public Opinion*, (Princeton, N. J.: Princeton University Press, 1944), p. 154.
[22] Gallup, George. *A Guide to Public Opinion Polls*, (Princeton, N. J.: Princeton University Press, 1944), p. 17.

In 1936, Henry A. Wallace, then Secretary of Agriculture, raised the problem of finding out what farmers thought about the agriculture program. It was decided to send trained observers into the field to sound out attitudes of farmers and report them to administrators in Washington. In 1939, Rensis Lickert was hired to head the Division of Program Surveys of the Department of Agriculture. Interviewers were to use the non-directive interview technique developed by Carl Rogers.[23] For example, a question to be studied might be how to increase the production of milk during the next two years. Department of Agriculture interviewers make contact with a representative sample of farmers on this subject and record everything that the farmer has to say on the subject. Responses are then coded in headquarters and, from the analysis of data, reports can be prepared for the guidance of administrative action. Scott, in describing this program, states:

"The interview form, then, was conceived of as a structure or skeleton of a discussion between the interviewer and the respondent. Questions were designed to be 'open-ended' in form, that is, to encourage discussion of the greatest possible range of attitudes with respect to any given topic. Out of the richness of the full interview reported has come the opportunity for obtaining more valid and more meaningful insights into the attitudes of individuals and groups than is possible with information from a polling questionnaire."[24]

Most private polling organizations cannot afford this technique of conducting studies. The cost of interviewing can be many times greater for the non-directive or depth interview than for the more formal ballot. Polling agencies obtain most of the benefits from the depth interview by conducting a score of them in the preparation of the ballot in order to make sure that the more important issues in the question will be covered. Link has criticized the depth interview and advocated the more formal ballot in the following manner:

"(1) An analysis of the term depth interview discloses that there is little or no evidence to support the tacit assumption that the so-called depth interview obtains more valid responses or truer responses from people than do other types. It may obtain a greater quantity and greater variety of information than is obtained by the formal interview. However, any informal interview may do the same. It would be more accurate, therefore, to speak of informal interivews in contrast with formal interviews.

(2) The informal interview may or may not be intensive, exhaustive, or exhausting. Whatever it is depends largely on the skills and peculiarities of the interviewer. The results are therefore bound to be highly personalized and difficult to evaluate and tabulate.

(3) The length and intricacy of the interview is no longer a measure of its probing power. An experimentally developed interview consisting of only a few formal questions and requiring only a few minutes may obtain more valid responses than the most elaborate and l o n g drawn-out informal interview."[25]

Lazarfeld in his discussion of this question wishes to combine these two methods. He points out that:

"The 'open-ended' is indispensable at the beginning of any study where it classifies the structure of a problem in all its details. It is also invaluable at the end of a study for anyone who is not satisfied with the mere recording of the low correlations we usually obtain. Good research consists in weaving back and forth between 'open-ended' and the more cut-and-dried procedures."[26]

Contril in this discussion of these two methods states:

"The major advantage of the open-ended or free-answer question is obviously its ability to record opinion which is catalogued to the minimum degree by the investigator. When an issue has become fairly clear-cut, however, or where common sense and experience have shown that meaningful alternatives can be posed, there is little advantage to an open-ended question from the point of view of its faithfulness in reporting opinion. There is even, on the contrary, a considerable disadvantage in the open-ended question from the point of view of reporting precise trends, keeping costs down, and avoiding bias in the coding of answers for statistical treatment."[27]

[23] Rogers, Carl. *Counseling and Psychotherapy* (New York: Houghton Mifflin and Co., 1942).
[24] Skott, Hans E., *op. cit.*, pp. 289-291.
[25] Link, Henry C. "An Experiment in Depth Interviewing," *Public Opinion Quarterly*, II (1943), p. 278.
[26] Lazarfeld, Paul F. "The Controversy Over Detailed Interviews, An Offer for Negotiation," *Public Opinion Quarterly*, I (1944), p. 59.
[27] Cantril, Hadley, *op. cit.*, p. 10.

Whether interviews should be directive or non-directive depends upon the type of problem studied, the amount of money available for interviewing, and the time permitted for research. In the initial stages of research, there is real value in conducting 20 or 30 non-directive interviews insuring that the more important phases of the problems are being covered. From this information, a ballot can be prepared and pre-tested with another small sample to determine if the questions are well worded and elicit proper responses. Sometimes it is necessary to pre-test a ballot on a small sample for a third time before the regular interview is conducted with large scale samples. Larger samples of the formal type are more easily given statistical treatment and depend less upon the ingenuity of the interviewer than does the informal interview.

Wording of the Question

Many studies have been made on wording of questions for polls. The words used must be simple and easily understood by all classes of respondents. Questions must be free from words of prejudice or prestige. Questions should be worded to elicit responses which reflect the true feeling of the respondent.

There is no one type of question that is best in all situations. Neither the dichotomous, the multiple-choice, or the free answer type is consistently superior. The chief advantage of the multiple choice is that it permits a greater range of responses; however, if 3 or 4 different alternatives are presented on a card, the respondent may become confused or irritated, and refuse to answer.

The dichotomous question has the advantage of simplicity, if the responses do not force an issue. The traditional answer of "Approve," "No Opinion," "Disapprove," or "Yes," "No Opinion," "No," is the method with which the public is most familiar.

The split ballot technique has been used with success to eliminate faulty wording in questions. Two questions of similar meaning but different wording are used on a ballot. One half of the interviewers use one question, and the second half use the alternative question. Thus the analysis of data would indicate any difference in responses that might be due to the factors of wording the question. Roper writes on the subject of wording the questions as follows:

> "No one would think of asking a question such as 'In the current controversy between militaristic Japan and the brave democracy of China, on which side do your sympathies lie?' "[28]

Likewise, no question such as the following could be used in conducting an attitude survey toward education: "Which do you prefer, godless secular education or religious denominational education?" Gallup summarizes his discussion of wording of the question as follows:

> "Normally, then, every question on which results are reported in the press by the American Institute of Public Opinion has met four tests at as many different stages in its polling cycle: First, it has been carefully worked and reworded by a staff experienced in the technique of simple and unbiased wording of questions. Second, it has successfully met all requirements in actual test interviews before it appears on the ballot. Third, it has met any split-ballot test which may have been indicated in the preballot testing. Fourth, it has met the final test in the field with the public as reported by scores of interviewers."[29]

Supervising Interviewers

The problem of properly supervising interviewers is one of the most difficult in this field. Gallup employs approximately 1,000 interviewers on part time basis and most of their instructions are given by mail. Roper, for the Fortune Magazine, has a much smaller staff of about 200, that are employed full time and given a course of training from two to six weeks. Williams has a good discussion of "Basic Instructions for Interviewers." He points out the necessity of having interviewers who are completely neutral and do not give suggestions to respondents, who fill in comments made by respondents, indicate "No Opinion" answers, and make sure that the questionnaire is completely filled out. He records the beginning of a typical interview as follows:

> "Interviewer: Good morning. (My name is Henry Jackson.) I am working on a survey in this neighborhood, and I would like to get your opinion on these few questions. For instance, the first one is: 'Where do you

[28] Roper, E. "Wording of the Questions for the Polls," *Public Opinion Quarterly*, I (1940), p. 129.
[29] Gallup, George, *op. cit.*, p. 41.

get most of your news, from the radio, or in the newspaper?'

Respondent: Over the radio. I seldom read newspapers.

Interviewer records answer and says: Thank you. Now I would like to know, 'Do you think young people in high school today are receiving better schooling, about the same kind of schooling, or not as good schooling as their parents did?'

Respondent: Well, I'd say about the same. What is all this about anyway? Very short explanation, etc."[30]

The question is often raised as to how a national organization can rely on the truthfulness of its interviewers. This problem is discussed by Crespi in his article *The Cheater Problem in Polling*. Cheating can be detected by (1) incongruity, (2) repetition of answers, (3) overly-meticulous ballots, and (4) revisions. Statistical analysis of interview results obtained from an interviewer who has been faking the ballots is quickly shown. There are many factors which tend to demoralize the work of interviewing. They are (1) ballot of unreasonable length, (2) too frequent "who's" and "what for's," (3) apparent repetition of question, (4) lengthy wording of the question, (5) antagonizing questions.

Since the contact of the interviewer with headquarters is largely by mail, there are many factors which account for administrative demoralization. These include the fact that interviewing is usually part time work, the salary is small, and the sample required by headquarters is frequently difficult to obtain. Crespi desires:

"A national body of full-time professional interviewers would eliminate the bulk of the factors which make for demoralization and fabrication. Through provision for systematic personal supervision, the demoralization factors inherent in mail contact as well as the opportunity for fabrication would be considerably diminished. Personal consultations would clarify all the difficulties in the ballot and lay down for the interviewers uniform interpretation and courses of action."[31]

Trained Versus Untrained Interviewers

What are the differences between trained and untrained interviewers? In an experiment conducted by the National Opinion Research Center, a ballot was tested using interviewers, one half of whom were trained and the other half untrained. The results of the study do not show conclusively that trained interviewers are significantly better than untrained, especially if the type of respondent to be selected by the interviewer is clearly stated. The Gallup Poll is conducted by interviewers who received most of their training and instruction by mail. The Fortune Poll is conducted by interviewers having a few weeks' training. The additional expense of training interviewers is necessary, considers Roper, Director of the Fortune Poll, for assuring proper classification of respondents in their correct social and economic class. It is a tendency on the part of interviewers to select respondents in the more articulate, well educated, upper income classes. Interviewers without training hesitate to find a sufficient proportion of respondents in the lower income groups.

Cantril in summarizing his conclusions writes:

"Although this experiment does not indicate that trained interviewers are superior to untrained ones, it does not necessarily follow that personal training and supervision of interviewers is of insufficient value to justify the expense involved. The head of the National Opinion Research Center staff stated, in submitting the list of interviewers who were to participate in the experiment, that he did not consider all of them to be really well trained. It is quite probable that a more intensive trained staff would have turned in work of a quality definitely superior to that of untrained interviewers. It is obvious that, although reasonably adequate work can be obtained from interviewers who are hired and supervised by mail, personal training and supervision of interviewers will keep the quality of personnel and work at a much higher level. American Institute of Public Opinion, recognizing this fact, has inaugurated a policy of sending representatives to the field to give their interviewers more intensive, personally supervised training."[32]

Previous Research Related to This Investigation

A careful check was made for previous studies in this field in the Educational Index, Encyclopedia of Educational Research, and Edu-

[30] Williams, Douglas. "Basic Instructions for Interviewers," *Public Opinion Quarterly*, III (1942), p. 637.

[31] Crespi, Leo P. "The Cheater Problem in Polling," *Public Opinion Quarterly*, IV (1945), p. 444.

[32] Cantril, Hadley, *op. cit.*, p. 97.

cational Review. There have been very few studies reported.

Bardwell, in his dissertation entitled, *Measuring Lay Attitudes Toward Public Education,* developed a scale using the Lickert technique having 5 alternative responses. This scale was used to determine which groups were most conservative or liberal in their attitudes toward public education. His recommendations state:

> "The first instrument of this kind is inevitably lacking in the completeness and the detail which will yield the most significant and the most useful results. If improvement and progress in public education is contingent upon the attitudes of those who support it, the more completely and clearly these attitudes are known the more intelligent and sound will be the steps which are taken in the development of the schools. The attitude scale developed in this study was the first of its kind. It should be followed by others which will criticize and improve a technique designed to give to the school administrator the essential information in regard to his community and its attitude toward the different services rendered by the public schools."[33]

Eye did further research in this field in a dissertation entitled *"Lay Attitudes Toward Education as Expressed in the Relationship of Beliefs, Facts and Sources of Authority."* In this study he administered the Fowlkes-Bardwel Scale, *What Do You Believe About Public Education,* and a test covering specific information about a local school system, in an effort to determine whether there was any relationship between the facts which respondents had about the school system and their attitudes toward education. He found no statistically significant results to indicate a relationship between the facts and attitudes test. Eye's conclusions were as follows:

> "The intensity of approval or disapproval of the school or the school program is not an index to the number of facts that the public knows about the school. Among the group in the community knowing the least number of facts about the school, there is slight relationship between fact and opinion. Among the group knowing the most facts about the schools, no relationship appears between fact and opinion. The time-honored assumption that *facts* are the prime factors in influencing public opinion does not hold when the relationship between *fact* and *opinion* is subjected to measurement and statistical treatment."[34]

One of the researches in this field using cross-section sampling methods is presented by Rope in his book, dated 1941, on *Opinion Conflict and School Support.* This study is an excellent discussion of public opinion measurement techniques as applied to education. In this study approximately 1,400 respondents were interviewed by upper classmen registered with the student employment service at the University of Pittsburgh. Each interviewer was assigned a certain number of interviews divided according to census tracts. One out of every ten interviews were rechecked to determine the accuracy and reliability of interviewers.

His study was an attempt to evaluate the attitudes of citizens in Pittsburgh towards the support of education. He had thirteen questions in addition to background information on the ballot. Among his conclusions he states:

> "Opinion research has immediate implications for the practicing education administrator who is deeply aware of the need to maintain a democratic public relations program. First, if new educational policies are contemplated, opinion research offers a means whereby the degree of public understanding and acceptance of the proposed course of action may be ascertained. Second, through properly conducted opinion research, channels of communication are e s t a b l i s h e d through which new educational policies may be suggested by the public. Third, through opinion research, weaknesses in the public relations program of a school system may be detected and s t r e n g t h s may be assessed. Fourth, to provide for opinion research, certain structural changes in administrative organization are desirable. From the Pittsburgh study can be drawn illustrations that suggest applications of opinion research."[35]

Rope suggests that in a large school system the responsibility for adjusting the school to community needs and to assist in carrying out an adequate public relations program an additional position should be created. He states:

> "His title is not particularly important, although Assistant Superintendent in Charge of

[33] Bardwell, R. W. *Measuring Lay Attitudes Toward Public Education* (unpublished dissertation) University of Wisconsin, 1939, p. 89.

[34] Eye, Glen G. *Lay Attitudes Toward Education as Expressed in the Relationship of Beliefs, Facts, and Sources of Authority* (unpublished dissertation) University of Wisconsin, 1942, pp. 112-4.

[35] Rope, F. T., *op. cit.*, p. 135.

School-Community Relations might be an apt designation. Among his functions would be: (1) the conduct of a continuous program of opinion appraisal; (2) articulation of the work of the schools and social agencies; (3) the development of adequate and attractive publicity; (4) the guidance of lay councils; (5) liaison between schools and organizational groups — business, civic, religious, and patriotic; and (6) promotion of professional relations with state and national agencies which deal with problems of education, youth, relief and other matters with which public schools must be directly concerned."[38]

[38] Rope, F. T., *op. cit.*, p. 144.

Chapter III

Background of Education in Montreal and Procedure Used in Conducting Investigation

In May, 1945, the Montreal Protestant School Board was without sufficient funds to give the teachers new contracts for the coming school year and the 1,400 teachers were dismissed. All during the summer of 1945, paid advertisements appeared in the papers presenting points of view of the school board as well as those of the teachers for solving the financial difficulties. Sharp differences of opinion were expressed by educational and lay community leaders concerning the financing of education, organization, buildings, curriculum, and like questions.

The following quotations taken from the *Montreal Daily Star* and *The Gazette* refer primarily to problems of school support arising out of a system of denominational school organization. There are many problems in this area that need to be studied in educational organization and administration, but this investigation was limited to an opinion survey of the basic goals of education desired by citizens of Montreal. Any attempt to study the problems of organization and administration of Protestant, Catholic, or Jewish education would require the cooperation and approval of the many different school boards. One of the newspaper accounts points out there are 11 Protestant school boards in addition to the Central School Board. All discussions with school board members and educational leaders tended to confirm the belief that a study of common objectives of education would be more profitable than to become involved in the highly controversial political questions immediately facing the schools.

Quotations from the Montreal Daily Star and the Gazette are as follows:

"PREMIER URGED TO RESCUE SCHOOLS — Resolution asking that the provincial government give immediate attention to the immensity of the problems arising from the financial situation of the Montreal Protestant Central School Board."[1]

"MEETING DEMANDED ON SCHOOL CRISIS—Feel Protestant rate payers will insist that local boards follow Outremount, and Westmount example. The emergency committee of the Montreal Protestant Teachers' Federation in a statement yesterday put it up to the public to decide whether or not the mass dismissal of some 1,400 teachers was to be rescinded."[2]

"HOME AND SCHOOL PRESIDENT LISTS POSSIBLE SOLUTIONS TO IMPASSE—The first solution as he saw it was for the central board to renew the contracts, borrowing the additional money from the banks to pay the salaries of the teachers for a whole year, provided the banks would loan the necessary funds. The second solution was for the central board to admit its inability to handle the financial situation and disband, having the provincial government, which had created the body, responsible for the maintenance of teachers' salaries. Third, Mr. Patience saw the board continue to ignore the teachers' situation and close the schools. The money, he said, must come from the Quebec provincial government. Local taxpayers could not pay more—the new cen-

[1] *The Gazette*, June 2, 1945, Montreal, Canada, p. 1.
[2] *Op. cit.*, August 10, 1945, p. 1.

tral board in his opinion, combining all district school boards, had great possibilities for increased economy of operation and better services, centering all boards under one head."[3]

"SCHOOL TO OPEN SEPT. 4TH WITH FUNDS FOR 3 MONTHS—The Central Board is preparing to employ any pay full salary to each of its teachers on a month-to-month basis until Nov. 30th, when its funds will be exhausted."[4]

"ZIONIST LEADER WILL SPEAK AT BANQUET—Now entering its 32nd year, the Jewish People's School has already had from 7,000 to 8,000 children studying the Jewish courses alone during the past three decades. The English-Jewish day school features a combined curriculum of Jewish courses and regular seventh-grade studies."[5]

"SOLUTION NEAR IN PROTESTANT SCHOOL CRISIS — The Central School Board, it was stated again emphatically today, will be only too glad to rescind the dismissal notices, thus bringing into force the 12-months' contracts, just as soon as the money is made available to pay the teachers.

Had the board not acted as it did, the Protestant school system could have been forced into bankruptcy after the end of November when funds would not have been available to pay the teachers, it was pointed out."[6]

"CATHOLIC SCHOOL BOARD REFUSES TO SIGN COLLECTIVE AGREEMENT—The executive council of the French teachers' group headed by Leo Guindon, president, met the Catholic School board commissioners in a last attempt to effectuate a settlement of the salary dispute which threatens to paralyse the education of 100,000 French-speaking children, if no immediate solution is found."[7]

"JEWISH SCHOOL PLEA VOICED—Exclusion of Jewish children from Outremont Protestant schools would add still further to the financial problem of the school system in that city.

Because Jewish children are educated in Outremont Protestant schools, that system receives $97 for each Jewish child, in school taxes from Jewish proprietors and the neutral panel, the speaker stated. Protestant ratepayers only make up $47 for each Protestant child, he said. Thus through Jews comes a contribution more than twice what Protestants pay. The only way in which Jewish children could be said to be contributing to a deficit was through the fact that it cost $124 to educate each pupil."[8]

[3] *Op. cit.*, August 10, 1945, p. 1.
[4] *The Gazette*, August 18, 1945, Montreal, Canada, p. 1.
[5] *The Montreal Daily Star*, August 22, 1945, Montreal, Canada, p. 17.
[6] *The Montreal Daily Star*, August 20, 1945, Montreal, Canada, p. 1.
[7] *The Gazette*, August 31, 1945, Montreal, Canada, p. 13.

The City of Montreal

Montreal is a large metropolitan city whose population according to the 1941 census is approximately 900,000 people. The Montreal Chamber of Commerce estimate of the population for the year 1945 was 1,333,000 for the city of Montreal and 1,537,000 for the metropolitan area. It is one of the two largest cities in Canada located on an island that is approximately 30 miles long and has an average width of 4 miles.

"The Montreal metropolitan area includes 7 cities, 20 towns, and 17 rural municipalities. Thus the whole metropolitan area includes no less than 45 separate administrative divisions. Montreal has two Universities, 4 specialized schools, 11 classical colleges for boys and 7 for girls, 12 high schools, 243 Catholic primary school and 47 Protestant ones. The average earning of a Montreal family for 1945 was $1,528."[9] The city is predominately French, but almost 50 per cent of the people speak both English and French. The 1941 census information shows that approximately 78 per cent are Catholic, 6 per cent are Jewish, and 16 per cent are Protestant.

Previous Surveys of Montreal School System

A search was made of the McGill University Library for previous studies related to this topic. Discussions were held with a number of the McGill University faculty members in the departments of education, psychology, economics, and sociology in an attempt to clarify the purpose and plan of the study and to find previous published or unpublished research.

Three surveys were found relating to the Montreal school system. They are: *Report of the Quebec Protestant Education Survey*, by W. A. F. Hepburn,[10] chairman of the survey,

[8] *The Montreal Daily Star*, March 9, 1946, p. 1.
[9] *The Gazette*, February 11, 1946, p. 3.
[10] Hepburn, W. A. F. *Report of the Quebec Protestant Education Survey*, 1938.

Guidance for the High School Pupil, A Study of the Quebec Secondary Schools, by E. C. Webster,[11] and *Las Reformes De L'Enseignement Premaire,* by Joseph Page.[12]

Briefly the Montreal school system is as follows. It is organized on the basis of denominational or religious schools. The Catholics and Protestants have the responsibility of providing their own school systems, which are tax supported largely by property taxes and by small tuition fees paid when the child is in high school. High school graduation usually means the completion of the eleventh grade or the Junior Matriculation. A student can continue through the twelfth grade and complete the Senior Matriculation. This twelfth grade is considered the first year of college in a traditional four year course.

The curriculum is largely the college preparatory course and the Catholic schools have some resemblance to that of Continental French classical education. Critics of the Montreal school system have contended that there is only one course of study and those pupils who cannot profit from it are dropped. Less than 50 per cent of those pupils graduating from elementary school go on to finish high school. Webster observed that "Only 68 per cent of those entering Grade VII commence Grade VIII" and that children "are rejected by an educational system which graduates some thirty of every hundred boys and girls fed into it."[13]

Origin and Organization of Education in Montreal

The system of Protestant and Catholic Education each supported by tax funds is embodied in the British North America Act of 1867. It states as follows:

"In and for each Province the Legislature may exclusively make Laws in relation to Education, subject and according to the following Provision:

1. Nothing in any such Law shall prejudicially affect any Right or Privilege with respect to Denominational Schools which any Class of Persons have by Law in the Province at the Union.
2. All the Powers, Privileges, and Duties at the Union by Law conferred and imposed in Upper Canada on the Separate Schools and School Trustees of the Queen's Roman Catholic Subjects shall be and the same are hereby extended to the Dissentient Schools of the Queen's Protestant and Roman Catholic Subjects in Quebec.
3. Where in any Province a system of Separate or Dissentient Schools exists by Law at the Union or is thereafter established by the Legislature of the Province, an Appeal shall lie to the Governor-General in Council from any Act or Decision of any Provincial Authority affecting any Right or Privilege of the Protestant or Roman Catholic Minority of the Queen's Subjects in relation to Education."[14]

Webster describes the organization of the Montreal School System as follows:

"In the Province of Quebec, there is a Superintendent of Education but no Minister of Education. The Provincial Secretary, who also controls technical and industrial education, represents this Department in the Cabinet. An English and a French secretary support him as deputy ministers. The former is the statutory Director of Protestant Education.

Two executive committees are co-ordinated in a Council of Education. One is Roman Catholic, the other Protestant. The Protestant Committee of the Council of Education consists of a number of members appointed by the Lieutenant-Governor-in-Council together with seven associate members, one of whom is a representative of the Provincial Association of Protestant Teachers of Quebec. These committees sit separately. Their independent powers are so complete that joint meetings are rare and occur only when school questions arise which affect the interest of both Roman Catholics and Protestants.

Each committee independently regulates the organization, administration, and discipline of their respective schools, the duties of school inspectors, and of the Central Board Examiners. Each has the responsibility of authorizing text books for use in schools of that faith, and no deviations from this authorized list may be made without the consent of the committee concerned. Education is governed in each municipality by a Board of School Commissioners. In certain of the larger Centres, including Montreal,

[11] Webster, E. C. *Guidance for the High School Pupil, A Study of Quebec Secondary Schools.* McGill University, 1939.

[12] Page, Joseph. *Les Reformes De L'Enseignement Premaire, Rapport De L'Enquete De L'Alliance Catholeque Des Professeurs.* Montreal, 1941.

[13] Webster, E. C., *op. cit.,* p. 8.

[14] McDclokie, H. *Canadian Government and Politics,* Toronto, Canada: Longsmans, Green and Company, p. 293.

Westmount, Quebec, and Sherbrooke, independent Boards of Commissioners are selected for both Protestants and Roman Catholics. By virtue of this organization the Protestants and Roman Catholics are able to conduct their own schools, and operate independently of one another."[15]

There are in Montreal 11 Protestant school boards and 1 Central board. In many aspects of school administration the local board and the central board find their powers overlapping. The Hepburn school survey observed that:

"Each of the local boards was deprived of its power to raise its own local revenue, and the resources of all were pooled. But each board was continued in existence and in the possession of most of the other powers which it had hitherto exercised. It could still appoint and pay its teachers, although the number of teachers employed and the scales of salaries had to be approved by the Central Board."[16]

The purpose of this investigation was not to study in detail the organizational and administrative functions of the separate Catholics and Protestants Boards but rather to determine what type of education or school experiences the citizens of Montreal wish to have for their children.

There are several conclusions of the Hepburn report that should be cited:

"1. Nature study, science, home economics, handwork, art, music, and social studies should receive more attention than is now given to these subjects.

2. Inasmuch as the personal, moral and social development of the pupil is one of the major ideals of education, the present policy with regard to religious instruction should be continued, and the provisions made for religious exercises and Bible instructions should be faithfully observed.

3. The present course of study on the Bible should be revised and extended to cover the high school grades, and in these grades at least a period a week should be devoted to it.

4. Games and sports should be encouraged not only for their health value, but as a moral training, provided the emphasis is placed on games and sports in which all play their part.

5. That systematic provisions should be made for the study of current events."[17]

Additional recommendations of the survey committee were to provide an extension of the services that the schools can render to the public, provide evening instructions for adults, and provide opportunity for adult vocational education. The committee recommends an extension of the curriculum in the fields of art, music, drama, craft-work and physical education.

Webster, in his conclusions, points out that there is but one course for students to take and this does not provide sufficient alternatives to meet individual differences in students. He says: "There exists only one secondary school course and this is geared so closely to the older faculties of the University that it now benefits no more than thirty per cent of students and perhaps only twenty per cent."[18] He suggests that there are two alternatives, that of lowering standards or providing a wider choice in the curricular offering. He says, "A broadening of curriculum is the preferable alternative. It implies, however, radical educational changes, a re-education of teachers, parents and school authorities, and a modernization of curriculum. The dual educational system in Quebec is complex, the Provincial Secretary, not the Protestant educationists, is responsible for technical education."[19]

Even the teaching staff recognize the limited offering in both the Protestant and Catholic schools. Page in his study of the attitudes of the Catholic teachers, found dissatisfaction in the organization and curricular offering of the Catholic schools.

Webster states that: "The teachers recognize the inflexibility of the present high school system and support the contention that Quebec has in reality only one high school course. They also state that the elective subjects do not provide alternatives satisfactory to pupils lacking in the particular abilities required of matriculation students."[20]

Procedure for Conducting This Investigation

In planning the interview schedule, discussions with many parents of school children, teachers, and community leaders were of help in focusing attention on the important prob-

[15] Webster, E. C., *op. cit.*, p. 8.
[16] Hepburn, W. A. F., *op. cit.*, p. 33.
[17] Hepburn, W. A. F., *op. cit.*, pp. 297, 300, 302.
[18] Webster, E. C., *op. cit.*, p. 114.
[19] Webster, E. C., *op. cit.*, p. 116.
[20] Webster, E. C., *op. cit.*, p. 118.

lems and issues. A list of tentative questions were discussed with several educational and lay leaders to make sure that the more important issues and objectives were covered. The questions had to be simple enough so that all levels of the population could understand them. The meaning of the words had to be identical for both the French and English ballots.

Assistance in wording of the questions obtained from two attitude scales toward public education: First, *What Do You Believe About Public Education, A Scale for Discovering Beliefs in Regard to the Public Schools,*[21] by John Guy Fowlkes and Richard W. Bardwell; and second, *What Should Our Schools Do,*[22] by Mort, Cornell and Hinton. However, many of the items on these scales are designed to measure a different type of thinking toward education such as one finds in a United States culture. The items that were used on the interview schedule had to be applicable to a bilingual, biracial, and denominational school culture.

Further assistance was secured from persons more experienced in public opinion measurement in Canada, to get the proper word meaning of the questions, thus insuring a better understanding by the respondent. For example, instead of referring to the problem of the relation between the French and English as race relations, this problem is called one of national unity. Item four on the interview schedule is a question on national unity.

After the items were selected the ballot was then pre-tested by conducting about 25 interviews in the English speaking section of the city, to make sure that each question was properly understood and to get additional criticism of the ballot as a whole. The questions were then translated into French, with some difficulty in finding synonyms which have the same cultural meaning, and the items were pre-tested in the French speaking and bilingual sections of the city by a bilingual interviewer to insure proper understanding of questions by respondents.

It was recognized that some items differentiated respondent opinion sharply and other items differentiated very little. These items which differentiated little were kept in the ballot because opinion on these questions appears in contrast to prevailing school policy and practice. No attempt was made to construct an attitude scale or test in which the items would differentiate on a continuum for all five responses. For example, if nine out of ten respondents approved increased vocational guidance in schools, this item was included because of the difference between the opinions of the lay public and school practice.

In deciding upon the proper allocation of interviews in a diversified city like Montreal, it is helpful to make use of previous opinion polls conducted in the city in order to obtain a representative sample. Sampling errors are most easily discovered when the results are tested against election returns. Elections thus become the test to determine whether the sample was adequate and representative of the area to be polled and studied.

In the summer of 1945, a group of bilingual interviewers working for the Canadian Institute of Public Opinion, conducted a poll of opinion in Montreal concerning the Dominion election held during July. The results based on approximately 450 interviews were in error by less than 2 per cent in comparison with election returns.

This previous experience was of help in the selection of a stratified sample. Samples and sampling procedures need pre-testing as well as does wording of the question.

Four bilingual interviewers, all graduate students in the department of psychology at the University of Montreal and with previous experience in polling procedures, were used in obtaining the sample. The sample consisted of 344 interviews costing approximately 35 cents per interview. The survey was conducted from April 8th to 16th, 1946.

Interviewers were instructed to make contact with respondents in their homes in certain designated sections of the city. For example, one interviewer might be instructed to get 30 interviews in a section known to be primarily below average in income group, French and Catholic, and to balance respondents according to sex and age groups. Interviewers were then free to select their own respondents within the limits of those controls.

By definitely allocating certain areas in the city where interviews were to be conducted, one insures a more representative geographical distribution of the sample, and does not rely so much on an interviewer's judgment in evaluating social status or economic classification. If

[21] Fowlkes, John Guy and Bardwell, R. W., *What Do You Believe About Public Education? A Scale for Discovering Beliefs in Regard to the Public Schools,* 1939.

[22] Mort, Paul R., Cornell, F. G., and Hinton, Norman H., *What Should Our Schools Do? A Poll of Public Opinion on the School Program.* (New York Bureau of Publication, Teachers College, Columbia University, 1938).

interviewers are not carefully instructed, especially in classifying economic status of respondents, they tend to have a disproportionate number of interviews from the middle and upper economic groups which live in the well-to-do sections of the city and from whom information is more easily secured.

In a public opinion study, interviews take more time at the beginning, until the interviewers become thoroughly familiar with the questions. Again when the sample is almost complete, it may take time to find respondents according to certain controls. When the sample is about complete and compares favorably with census, social service or other criterion data, it sometimes becomes necessary to send an interviewer to find respondents according to specific controls. For example, one might need 10 interviews from men, in the poor section, where respondents are primarily English speaking.

Size of Sample

A sample is large enough in size when an increased number of cases fails to produce any significant differences in results. In designing the sample, it was planned to have two parallel forms of the sample and each representative according to the control factors. In other words, is there any difference between a sample one half as large or 172 cases, and the final one of 344 cases? The ballots were hand-tabulated for items 2, 7, 13, and 19, and no significant differences were found between the raw scores for the two parallel forms. An increased number of interviews would not have significantly changed the results. Later when the ballot was transferred to the I. B. M. cards for counting and sorting, a comparison was made for all twenty-two items and there was no significant difference between the two parallel samples. Other statistical techniques to determine whether the sample is large enough and confidence limits for percentages are presented in chapter four.

Information on the ballot was planned to be easily transferred to the I. B. M. cards for counting and sorting. The first 22 rows on the cards were used for the items on the ballot. The next seven rows were used for coding background factors.

Thus it was possible to divide the cards according to men and women, and then sort the responses for each of the 22 items. The cards were then assembled and redivided according to the other background factors of age, language, social status, religion and education. For each of these background factors there were 3 subgroups. When the cards were sorted according to age, there were 3 different groups, the 18-29 years, 30-49 years, and 50 years and over. The cards were then put through the sorter and counter for each of the 22 items according to age groups. Thus it was possible to compare responses for each item according to age group. This same procedure was repeated for each of the 6 background or control factors used in the investigation.

Reference is made to Appendix "A", which is the complete ballot used, with English and French translations.

Appraising the Representativeness of the Sample

The purpose of stratified sampling is to obtain a cross-section of the population universe that is to be studied, and should represent a true miniature of the total population. For this purpose 3 background factors, those of sex, age, and religion, were carefully controlled. Social status was partially controlled, but without the most objective criterion with which to compare the sample. Education and language tend to be representative by the process of random sampling, but there was no objective criterion with which to make comparisons.

Table I compares census information with that of the sample for sex, age, and religion. It is evident that the sample is representative for religion with less than one per cent difference between the sample and the census data. For sex the difference between the sample and the criterion is about 1½ per cent. The greatest difference between the sample and the criterion are found in the age group. Here the sample is off 2.46 per cent for the 18-29 year group, 3.40 per cent for the 30-49 year group, and 5.86 per cent for the 50 year and over group. There is no attempt made to minimize the discrepancy between the sample and the criterion; however, because the numbers were small for the 50 years and over group, 4 or 5 additional interviews in this group would bring the percentage differences for all three groups in closer approximation with that of census information.

A further comparison is made to determine the goodness of fit for background factors of sex, age, and religion by using the Chi-Square Test. Table II shows these comparisons, and appendix "B" further explains the nature of the Chi-Square Test.

TABLE I

COMPARISON OF BACKGROUND FACTORS OF SEX, AGE AND RELIGION FOR MONTREAL WITH SAMPLE STUDIED

	Population in Montreal	Number in Sample	Per cent of Population City of Montreal	Sample Studied	Difference in Percentage
Sex	440,701	173	48.80	50.29	1.49
Men	462,306	171	51.20	49.71	1.49
Women					
Total	903,007	344	100.00	100.00	
Age	200,881	118	31.84	34.30	2.46
18-29 yrs.	268,272	158	42.53	45.93	3.40
30-49 yrs.	161,659	68	25.63	19.77	5.66
50- yrs. & over					
Total	630,812	344	100.00	100.00	
Religion	699,885	269	78.20	78.20	.00
Catholics	144,369	57	16.13	16.56	.43
Protestants	50,772	18	5.67	5.23	.34
Jews					
Total	895,026	344	99.99	99.99	

TABLE II

CHI-SQUARE TEST TO DETERMINE GOODNESS OF FIT OF SAMPLE WITH CENSUS INFORMATION FOR CERTAIN BACKGROUND FACTORS

Background Factor	Value of Chi-Square	Probability Limits
Sex	.08	.70 P .80
Age	1.8	.30 P .50
Religion	.03	.98 P .99

The numbers in the percentage column of this table give the upper and lower limits of the probability that as large a Chi-square would be obtained by pure random sampling of the population; or, in other words, the probability that a worse fit would be obtained by random sampling. The chi-squares are not large enough to reject the hypothesis that our sample is representative of the population of Montreal.

It would perhaps be better to describe the three sub-groups under social status as below average, average, and above average. To make the discussion more understandable, the terms used are poor, average, and wealthy. To persons unfamiliar with public opinion measurement, there would be a tendency to distribute these proportions according to a symmetrical curve, such as 25 per cent wealthy, 50 per cent average, and 25 per cent poor. Cantril points out that: "A rough scale to bear in mind is that the upper-income group is about 15 per cent of the population, the middle-income group is about 35 per cent, and the lower-income group about 50 per cent."[23] The sample used in this study had 16.86 per cent in the wealthy group, 39.53 per cent in the average group, and 43.60 in the poor group. The percentages in the sample for social status subgroups of Montreal closely approximate social service estimates and Canadian Institute of Public Opinion estimates of social status. All of the 4 interviewers had previous experience in public opinion interviewing and estimating the social status of a respondent.

[23] Cantril, Hadley., *op. cit.*, p. 152.

It is difficult to accurately determine the number of persons who are bilingual in Montreal, that is, who can speak both French and English. First of all, what degree of competency must one have in both languages to be considered bilingual? Chamber of Commerce estimates that approximately 50 per cent of the population of Montreal are bilingual. One finds more bilingualism in the age groups over 10 and under 50. The sample studied had 25.87 per cent in the "French only" group, 19.77 per cent in the "English only" group, and 54.36 per cent in the bilingual group. Census information was not applicable for this control because: (1) it is over 5 years old, (2) the breakdown was for the total population rather than by the age groups covered by the sample, and (3) Montreal has increased by approximately ¼ in population since the 1941 census. Interviewers merely asked re-

spondents their language and could not attempt to check the accuracy of answers.

It is difficult to get accurate statistical information or estimates of the level of education for the population of Montreal. Checks were made with most available sources of information for these statistics. The division of elementary, some high school, and finished high school divided the population into the most meaningful groups. In the Montreal area, one finds different terms used to describe levels of educational attainment. For example, there are many secondary schools that are called colleges which have a student body in the age group from 14 to 17 years of age.

To ask a respondent how far he or she has gone in school raises a question of social prestige, and therefore it is difficult to get true and accurate information. As a further check in classifying responses, the interviewers asked at what age the respondents quit school. The sample studied had 42.44 per cent in the "elementary school" group, 23.55 per cent in the "some high school" group, and 34.01 per cent in the "finished high school" group.

One may conclude that by getting a representative sample held in proper proportions for sex, age, religion, and social status, by the process of randomization, one will get approximately a representative cross section for the background factor of education.

A statistical device to overcome any differences between the sample characteristics and those of the true criterion may be eliminated by weighting procedures. That is, by properly weighting the sample characteristic that one finds is at variance with the true population proportion, one can generalize regarding the total group being studied, even though the sample is not completely representative. The errors for age groups were not large enough in this study to use any weighting procedure.

In view of the data presented in Tables I and II and from the further discussion of the control factors of social status, language, and education, one can assume that the sample studied tends to approximate the true proportions for background factors for Montreal. No attempt is made to minimize the inadequacy of the criteria to which the sample is being compared. The statistical treatment of confidence limits on percentages presented in Chapter 4 is a further check limiting unwarranted generalizations from the data studied.

Chapter IV

Analysis of Respondent Opinion

The second major objective of the study here reported was to make a statistical analysis of the respondent opinion toward the various questions raised on the interview schedule. The analysis was made first for the entire population of Montreal and then broken down for each item. Finally, each item was analyzed according to its ability to discriminate according to certain background factors.

On the orignial ballot a 5 point scale was used to discriminate intensities of opinion response. Most of the items were checked by the interviewer as either "strongly approve", "approve", "no opinion", "disapprove", or "strongly disapprove". For a few of the items, other classifications had to be used such as in the case of item twenty where the responses to be checked were: One,—"strongly denominational", Two, "denominational", Three, — "no opinion", Four, — "secular", Five, — strongly secular".

For most of the ballot, columns one and two which are "strongly approve" and "approve" have been added together and columns four and five were also added. Research by Lickert and Murphy has shown that a 3 point scale correlates highly with a 5 point multiple choice. This coefficient of correlation was found to be approximately .92.

It was further necessary to convert the 5 point scale into a 3 point scale in order to have sufficiently large numbers for each response to make possible certain statistical analyses which seemed desirable.

Table III is an analysis of opinion response towards each of the twenty-two items on the interview schedule.

TABLE III

RELIABILITY OF RESPONSES TO ITEMS ON INTERVIEW SCHEDULE

Description of Item	Per cent N=344	Standard Error of Per Cent	Interval Estimate in Per Cents* (Confidence Coefficient .95)
1. Is education improving			
Yes	71.80	2.42	76.45 — 67.15
No Opinion	3.49		
No	24.70		
2. Research and Experimentation in Education			
Approved	88.38	1.72	91.75 — 85.01
No Opinion	4.94		
Disapproved	6.69		
3. Physical punishment for school children			
Approved	34.31		
No Opinion	3.20		
Disapproved	62.50	2.60	67.59 — 57.41
4. Increased social studies emphasis on national problems			
Approved	84.01	1.97	87.87 — 80.15
No Opinion	6.11		
Disapproved	9.88		
5. Increased social studies emphasis on international problems			
Approved	64.25	2.58	66.83 — 61.67
No Opinion	6.40		
Disapproved	29.36		
6. Effect of new school buildings on attitude toward home			
Approved	75.59	2.31	81.12 — 71.06
No Opinion	5.81		
Disapproved	18.61		
7. Increased physical culture and athletics			
Approved	95.35	1.13	97.56 — 93.14
No Opinion	2.03		
Disapproved	2.61		
8. Increased extra-curricular activities			
Approved	92.15	1.44	94.97 — 89.33
No Opinion	2.91		
Disapproved	4.94		
9. Increased emphasis on industrial education			
Approved	87.21	1.80	90.74 — 83.68
No Opinion	8.14		
Disapproved	4.65		
10. Changes in the school program involving additional money			
Approved	60.47	2.63	65.62 — 55.32
No Opinion	10.76		
Disapproved	28.78		
11. Increased medical and dental services			
Approved	89.25	1.67	92.52 — 85.98
No Opinion	3.20		
Disapproved	7.56		
12. Permit speakers in schools who express minority opinions			
Approved	59.60	2.68	64.85 — 54.35
No Opinion	10.76		
Disapproved	29.65		

RELIABILITY OF RESPONSES TO ITEMS ON INTERVIEW SCHEDULE

Description of Item	Per cent N=344	Standard Error of Per Cent	Interval Estimate in Per Cents* (Confidence Coefficient .95)
13. Religion versus education for character building			
Religion	49.42	2.69	54.69 — 44.15
No Opinion	9.59		
Education	40.99		
14. Extension of free education beyond high school			
Approved	77.62	2.25	80.03 — 73.21
No Opinion	9.59		
Disapproved	12.79		
15. Increase teachers' salaries in Montreal			
Increase	66.86	2.53	71.82 — 61.90
Remain the same	31.40		
Decrease	1.74		
16. Increased provincial support of education			
Approved	80.81	2.12	84.97 — 76.65
No Opinion	13.66		
Disapproved	5.52		
17. New and modern school buildings result in better education			
Approved	46.22	2.69	51.49 — 40.95
No Opinion	10.77		
Disapproved	43.01		
18. Continue the same or increase religious education in the schools			
Approved	76.74	2.28	81.21 — 72.27
No Opinion	7.28		
Disapproved	15.98		
19. Increased vocational guidance			
Approved	93.60	1.31	96.17 — 91.03
No Opinion	2.03		
Disapproved	4.36		
20. Secular versus Denominational education			
Secular	29.65	2.46	34.47 — 24.83
No Opinion	13.37		
Denominational	56.97		
21. Elected versus appointed school board members			
Elected	54.65	2.68	59.90 — 49.40
No Opinion	18.60		
Appointed	26.74		
22. Adjusting school offering versus maintaining standards			
Adjust school offering	54.65	2.68	59.90 — 49.40
No Opinion	5.52		
Maintain Standards	39.82		

* The figures in this column were obtained by multiplying the standard error of the percentage by 1.96. This sum was then added or subtracted to the response percentage to obtain confidence limits of 95 per cent.

The twenty-two items on the ballot could be grouped together into major classifications such as curriculum, school buildings, organization, supervision, administration, finance, and others. However, for clear discussion on opinion response, it appeared more desirable to treat each item separately without attempting any classification.

In item one, 71.80 per cent of the population thought that education had improved since they had attended school, 3.49 per cent were of no opinion, and 24.70 per cent did not see signifi-

cant improvement. The standard error of the "approved" percentage was 2.42 per cent. The formula used for computing this value is:

$$\sigma_p = \sqrt{\frac{pq}{N}}$$

where p represents the percentage in favor, q represents the percentage of all other responses, and N equals the total number of responses. This was computed as follows: the 71.80 per cent was multiplied by the sum of the "no opinion" and "disapprove" responses. Thus 71.80 times 28.20 equals 2024.76. This sum was then divided by the total number of ballots which was 344, giving a result of 5.89. The square root of this number is 2.42, which equals the standard error. Thus one can say that if an infinite number of samples of this size were taken at random, in approximately sixty-eight per cent of the samples the favorable opinion response to item one would lie between 71.80 plus or minus 2.42 per cent. In order to determine the confidence limits at the confidence coefficient .95, the standard error was multiplied by 1.96 or approximately two sigmas. This sum plus or minus gives us the interval estimate in per cents at the .95 confidence level. Thus in repeated samples ninety-five times out of a hundred the approved response would be between 67.15 and 76.45 per cent.

For item two, respondents in Montreal overwhelmingly approved of research and experimentation in education with 88.38 per cent indicating "approve" and 6.69 indicating "disapprove".

Opinion appeared to be more evenly divided among respondents in Montreal for the question of physical punishment for school children with 34.61 per cent indicating "approve" and 62.50 per cent "disapprove".

Items four and five compared respondent opinion toward increased social study emphasis on national problems and international problems. Increased emphasis on the study of national problems in social science courses was approved by 84.01 per cent, whereas 64.25 per cent believed that increased emphasis should be placed on the study of internation problems.

Item six and item seventeen might be compared together, whereas 75.59 per cent of the respondents did not think that new school buildings would make children dissatisfied with their homes, only 46.22 per cent of the respondents believed that new and modern school buildings result in better education.

Items seven and eight dealt with problems of extra-curricular activities. Increased physical culture and athletics were approved by 95.35 per cent and 92.15 per cent approved of increasing extra-curricular activities such as debating, clubs, and school papers. These two items were included, even though they did not discriminate sharply, to ascertain how sharply lay attitudes are at variance with school practice. Neither Protestant nor Catholic schools apparently are offering these educational experiences to the degree desired.

Item nine raised the question of increased stress on industrial education. One finds 87.21 per cent of the respondents indicating approval.

Item ten reflected the respondents' general attitude toward school support and the degree of confidence that school funds are used efficiently. Changes in school program involving additional money was approved by 67.04 per cent, 10.76 per cent were of "no opinion" and 28.78 per cent indicated "disapprove". Item eleven raised the question of increased medical and dental services to be given through the schools. One finds 89.25 per cent of the respondents indicated a desire to see an increase in these services.

Item twelve raised the problem of the extent to which all points of view, even those of minority opinions, should be expressed in the school. Respondents approved permitting speakers in the school who express minority opinions by 59.60 per cent, 10.76 per cent were of "no opinion", while 29.65 per cent disapproved.

Since Montreal schools are dendminational, and there exist both Catholic and Protestant schools, three questions were asked of the respondent about various aspects of religious teaching in the schools. Items thirteen, eighteen and twenty deal with this problem. Item thirteen posed the question, "Do you think that church and religion are more important than school education in building character?" One finds that 49.42 per cent said "yes", 40.99 per cent said "no", and 9.59 were of "no opinion".

Since religion is taught in both Protestant and Catholic schools, the question was raised as to how much time should be devoted to religious instruction: more than at present, about the same, less than at present, or none at all. Respondents approved the same or increased religious education in the schools by 76.74 per

cent. They wished less or no education in the school by 15.98 per cent.

While most of Canada other than the province of Quebec has predominately secular education, the school systems in Montreal are denominational and supported by tax funds. Respondents approved denominational schools by 66.77 per cent, 13.37 per cent were of "no opinion", and 29.65 per cent approved secular education.

Item fourteen raised the question of free education beyond high school. One finds 77.62 per cent indicated "approve", whereas 12.79 per cent indicated "disapprove".

Table IV, which presents "intensity ratios", is the only table using the five point scale: (1) "Strongly Approve", (2) "Approve", (3) "No opinion", (4) "Disapprove", and (5) "Strongly disapprove".

TABLE IV

INTENSITY RATIOS FOR ITEMS ON INTERVIEW SCHEDULE

Number of item	Favorable *	Unfavorable *
1	.77	.57
2	.73	.52
3	.45	.75
4	.63	.47
5	.62	.66
6	.56	.69
7	.84	.44
8	.73	.41
9	.77	.44
10	.67	.66
11	.83	.31
12	.61	.63
13	.61	.50
14	.60	.43
15	.62	.50
16	.72	.68
17	.63	.54
18	.33	.13
19	.77	.52
20	.75	.57
21	.78	.70
22	.72	.64

* By "favorable" is meant all responses which fall in blanks one and two on the ballot and by "unfavorable" is meant all responses which fall in blanks four and five.

The computation indicates a ratio between the "Strongly Approve" responses and all favorable responses. It also gives one the ratio between the "Strongly disapprove" and all unfavorable responses. These measures indicate the intensity of opinion on the various questions, that is, an intensity ratio of .77 in the favorable column means that, of all responses in the first two columns, 77% fell in the first column.

Item 18 is of interest because 25 per cent of the respondents favored more religious education, 51.75 per cent favored the same amount of religious education, 7.28 per cent were of no opinion, 13.95 per cent favored less religious education, and 2.03 per cent desired no religious education in the schools.

METHOD OF ANALYZING OPINIONS IN TERMS OF BACKGROUND FACTORS

The various items on the ballot could not be satisfactorily averaged together in any manner to give total opinion response. Instead, each item was considered a test in itself. The question is raised as to how the various items discriminate according to the background factors of sex, age, language, social status, education, and religion. For example, do older people think that education has improved more than do younger people? Or, do French favor secular education to a greater or less extent than the English speaking people?

To determine whether there was a statistically significant difference between opinion responses of one group in contrast to another, three statistical techniques were available. They were the chi-square technique, determination of differences between two per cents and analysis of variance. Of these three, the chi-square test and the determination of differences between two per cents were the most applicable to the data.

For a discussion of the statistical computations needed to determine chi-square, reference is made to Appendix "B".* The Chi-Square test determines whether the percentage difference one finds between two groups may be attributed to some factor other than chance. For example, if differences exist between the "approve", "no opinion", and "disapprove" per cent responses of Catholics, Protestants, and Jews, the chi-square test indicates whether those percentage differences are statistically significant. In using this test, one starts out with the null hypothesis, that is, one assumes that there is no real difference between the opinions of the three groups, Catholics, Protestants, and Jews. If the chi-square obtained is sufficiently large that the probability of getting as large a chi-square in repeated random samples of the

* See original thesis on file, University of Wisconsin Library.

same size is .05 or less, one can reject the null hypothesis and conclude that there seems to be a relationship between the attributes, that is, in this case, between religion and opinion.

Table V shows which items differentiate at the .05 level and at the .01 level. For example, item one which raises the question whether education is improving differentiates for language, social status, education, and religion. It does not differentiate for sex or age.

TABLE V

SIGNIFICANCE OF CHI-SQUARES TO ITEM RESPONSES GROUPED ACCORDING TO BACKGROUND FACTORS

Description of item	Sex	Age	Language	Social Status	Education	Religion
1. Is education improving	..	..	.05	.05	.01	.05
2. Research in Education	..	..	..	..	..	..
3. Physical punishment	..	..	..	..	.05	.05
4. National problems	..	.05	..	..	..	..
5. International problems	.01	.01	.01	.01	.01	..
6. School buildings	..	..	..	.01	.01	.01
7. Physical culture	..	..	..	..	..	..
8. Extra-curricular Act	.05	..	..	..	..	..
9. Industrial education	.05	..	.05	..	.01	..
10. School Support	..	..	..	..	..	..
11. Medical and dental service	..	..	.01	..	..	..
12. Express minority opinion	..	..	..	.01	.01	..
13. Character building	.05	..	..	.01	.05	..
14. Free education	..	.01	..	.05	..	..
15. Teachers' salaries	..	.01	..	.05	..	..
16. Provincial support	..	..	..	..	..	.01
17. New school buildings	.01	..	.05	.05	.05	..
18. Religious education	..	..	.01	..	..	.05
19. Vocational guidance	..	..	..	..	..	..
20. Secular education	..	..	.01	.01	.01	.01
21. School board	.05	..	..	.01	.05	.01
22. Adjust curriculum	..	..	..	..	.05	..

(Level of Significance at .01; level of Significance at .05; (..)Chi-Square not statistically significant)
Reads as follows: Item one does not discriminate at a statistically significant level for background factors of sex or age; it discriminates at the .05 level for language, social status, and religion; it discriminates at the .01 level for education.

An analysis of Table V shows the discriminating ability of each item on the ballot according to background factors.

Table VI indicates the rank of background factors according to the number of items which discriminate at a statistically significant level. It is evident that education and social status discriminated more highly than did the other four background factors. Both sex and age had less ability to differentiate among items. For example, one finds more differences on the entire ballot between opinions of respondents having elementary school education, and those having completed high school than is found between opinions of Catholics and Protestants or between young people and old people.

Table VI is interesting because one presumes that the cultural influences of religion and language would cause greater differences of opinion than amount of education or social status of the respondent.

TABLE VI

ITEM DISCRIMINATING ABILITY BY CHI-SQUARE TEST RANKED ACCORDING TO BACKGROUND FACTORS

Background factors	Rank	Number of Items Discriminating at .01 Level of Significance	Number of Items Discriminating at .05 Level of Significance
Education	1	6	5
Social Status	2	6	4
Religion	3.5	4	3
Language	3.5	4	3
Sex	5	2	4
Age	6	3	1

The plan or procedure used in presenting the various tables indicating detail breakdown of background factors was as follows: first, a

table indicating responses to all twenty-two items broken down according to the two or three sub-group classification. The reader will need refer to Appendix "A", which gives the complete question to each item. Second, selected items which discriminate at a statistically significant level are presented following the complete ballot. Third, those items which discriminate at the .01 level according to the chi-square test are further analyzed by determining the significance of the difference between two per cents.

Tables are presented in the order as they tend to discriminate between items according to background factors. Table VII indicates all items broken down according to education. In Table VIII one finds selected items broken down according to education.

Opinion Responses to Selected Items Classified According to Education of Respondent

In Montreal the classification of education as "elementary", some high school", and "finished high school" appeared to fit more appropriately into the cultural pattern. It is exceedingly difficult to get a true response from a respondent as to the exact amount of schooling completed. As a further check the respondent was asked at what age he or she dropped out of school. Because of the prestige factor involved, respondents tend to indicate a higher level than they actually have and therefore it is difficult to get a completely accurate response.

Table VII

Responses to All Items in Percentages Classified According to Education of Respondent

	Elementary			Some High School			Finished High Sc.			Chi-Square	Level of Sign.
	N = 146			N = 81			N = 117				
Item	1 & 2**	3	4 & 5	1 & 2	3	4 & 5	1 & 2	3	4 & 5		
1.	80.82	3.42	15.75	72.83	3.70	23.45	59.83	3.42	36.75	15.67	.01
2.	88.35	6.16	5.45	87.65	4.94	7.40	88.89	3.42	7.69		*
3.	37.67	2.74	59.59	27.16	8.64	64.20	34.19	.85	64.96	10.74	.05
4.	78.09	7.53	14.38	91.36	4.94	3.70	86.32	5.13	8.54	8.38	*
5.	52.74	9.59	37.67	74.07	1.23	24.69	71.79	5.98	22.22	17.07	.01
6.	30.13	1.37	68.49	8.64	13.58	77.77	11.11	6.84	82.05	32.55	.01
7.	94.52	2.05	3.42	95.06	2.47	2.47	96.58	1.71	1.71		*
8.	88.37	4.79	6.85	92.58	.00	7.40	96.58	2.56	.85		*
9.	90.41	4.11	5.47	80.24	18.52	1.23	88.04	5.98	5.98	17.65	.01
10.	32.19	13.01	54.80	24.69	11.11	64.19	27.35	7.69	64.95	4.22	*
11.	89.04	2.74	8.22	91.36	3.70	4.93	88.03	3.42	8.54		*
12.	50.00	9.59	40.41	62.96	9.88	27.16	69.23	12.82	17.95	16.35	.01
13.	54.80	4.79	40.41	53.08	12.35	34.57	40.17	13.68	46.15	10.86	.05
14.	83.56	6.16	10.27	69.13	14.81	16.05	76.07	10.26	13.67		*
15.	65.76	32.19	2.05	61.72	34.57	3.70	71.80	28.21	.00	5.29	*
16.	80.14	14.38	5.48	81.48	11.11	7.40	81.20	14.53	4.27		*
17.	43.15	8.22	48.63	41.97	18.52	39.51	52.99	8.55	38.46	9.59	*
18.	79.45	8.22	12.33	81.47	7.41	11.11	70.08	6.84	23.07	7.43	*
19.	93.83	1.37	4.79	92.59	4.94	2.47	94.02	.85	5.12		*
20.	70.55	8.90	20.54	51.85	17.28	30.86	43.59	16.24	40.18	21.09	.01
21.	47.94	26.71	25.34	62.96	12.35	24.70	57.26	12.82	27.91	12.03	.05
22.	31.51	5.48	63.02	48.14	8.64	43.20	44.44	3.42	52.14	11.33	.05

** Refers to the various column responses to each item. For example, 80.82 per cent of the respondents having elementary education indicated approval to item one by responding in columns one and two. 3.42 per cent indicated no opinion. 15.75 indicated disapproval.

* Chi-Square was not at a statistically significant level.

TABLE VIII

RESPONSES IN PERCENTAGES TO SELECTED ITEMS CLASSIFIED ACCORDING TO EDUCATION OF RESPONDENT

Type of Response to Item	Elementary N = 146	Some High School N = 81	Finished High School N = 117	Chi-Square	Level of Signif.
1. Is education improving					
Yes	80.82	72.83	59.83	15.67	.01
No Opinion	3.42	3.70	3.42		
No	15.76	23.45	36.75		
3. Physical punishment					
Approve	37.67	27.16	34.19	10.74	.05
No Opinion	2.74	8.64	.85		
Disapprove	59.59	64.20	64.96		
5. International problems					
Approve	52.74	74.07	71.79	17.07	.01
No Opinion	9.59	1.23	5.98		
Disapprove	37.67	24.69	22.22		
6. School buildings					
Approve	68.49	77.77	82.05	32.55	.01
No Opinion	1.37	13.58	6.84		
Disapprove	30.13	8.64	11.11		
9. Industrial education					
Approve	90.41	80.24	88.04	17.65	.01
No Opinion	4.11	18.52	5.98		
Disapprove	5.47	1.23	5.98		
12. Express minority opinion					
Approve	50.00	62.96	69.23	16.35	.01
No Opinion	9.59	9.88	12.82		
Disapprove	40.41	27.16	17.95		
13. Character building					
Religion	54.80	53.08	40.17	10.86	.05
No Opinion	4.79	12.35	13.68		
Education	40.41	34.57	46.15		
17. New school buildings					
Approve	43.15	41.97	52.99	9.59	.05
No Opinion	8.22	18.52	8.55		
Disapprove	48.63	39.51	38.46		
20. Secular education					
Approve	20.54	30.86	40.18	21.09	.01
No Opinion	8.90	17.28	16.24		
Disapprove	70.55	51.85	43.59		
21. School board					
Elected	47.94	62.96	57.26	12.03	.05
No Opinion	26.71	12.35	12.82		
Appointed	25.34	24.70	27.91		
22. Adjust curriculum					
Approve	31.51	48.14	44.44	11.33	.05
No Opinion	3.48	8.64	3.42		
Disapprove	63.02	43.20	52.14		

* Chi-Square was not at a statistically significant level.

The greatest difference of opinion broken down according to background factors appeared in this table on education. There were six items which discriminated at the .01 level, and five items which discriminated at the .05 level.

Item one raises the question whether the respondent considers education to be improving: 80.82 per cent of respondents having elementary education thought that education was improving, 72.83 per cent of the middle group thought likewise, and 59.83 per cent of the upper group felt that schools were now better than when they received their education. Thus it is evident that the higher a person's level of educational attainment, the more critical he is of educational improvement.

Regarding physical punishment for children, the data indicates that it was approved more

by the respondents having elementary education than by the respondents in the other two categories.

The study of international problems in the school was desired more strongly by the more educated groups than those having elementary education.

Item six and item eleven deal with the question of school buildings. Item six, which is repeated in total here, is: If school buildings are new and modern do you think that school children will become dissatisfied with their homes? For this question, 68.49 per cent of those respondents having elementary education said "no", while 82.05 per cent of those finishing high school said "no". To question seventeen, "Do you think that children get a better education in new and modern school buildings?", we find that 43.15 per cent of the respondents having elementary education said "yes", while 52.99 per cent of the respondents who have finished high school said "yes".

It is interesting to observe in this item that general approval of new school buildings for the improvement of education did not exist to the extent one might presume.

Item twelve refers to the problem of expressing all points of view in the school. The elementary group approved of this by 50.00 per cent while those finishing high school approved by 69.23 per cent.

The elementary group appeared to have greater confidence in the ability of religion rather than education in building character. Conversely, those respondents who have finished high school believed that education is of greater importance in building character than those respondents who were in the elementary group.

Sharp differences of opinion existed on item twenty, which raises the question of secular versus denominational education. Secular education was approved by about twice as many respondents who completed high school as in the elementary group.

Item twenty-one raises the question whether school board members should be elected or appointed. There was greater preference among respondents in the group who finished high school for the election of school board members than among respondents in the elementary school group.

Item twenty-two poses the question whether children who cannot carry the regular school program should be dropped from school or whether standards should be adjusted to individual needs. The respondents who were in the elementary school group preferred adjusting the school program to pupil needs to a greater extent than respondents in the other two groups.

Table IX is a further analysis to determine the standard error and critical ratio between two percentages for selected items by respondents of different levels of education. Appendix C* gives greater detail of the statistical procedure used in arriving at these answers. For example in question one, 88.62 per cent of those respondents in the elementary group said "yes" to this question, while 72.83 per cent in the some high school group said "yes", and 59.83 per cent in the finished high school group said "yes".

Are these differences in percentages statistically significant? Most writers in educational statistics require that the difference between two percentages be three times the standard error before one can say with assurance that the differences are significant and not due to chance. For example, on Table IX, item 1 does not differentiate at a statistically significant level between Groups I and II, since the critical ratio is less than 3. It does, however, differentiate between Groups I and III, since the critical ratio is 3.76. Thus one can conclude that the difference in opinion responses are not due to chance, but seem to be attributable to the different level of education.

One can see that there was a difference of over 30 per cent between respondents having elementary education and those completing high school in their belief that education is now better than when they attended school. The critical ratio was over the 3 point level and is statistically significant.

There was approximately 20 per cent difference between the low and high educational groups in their attitudes toward teaching international relations in the schools. Respondents having more education wished greater study of international problems than respondents with less education.

The higher the educational level, the greater was the certainty that better school buildings result in better education.

In willingness to permit freer expression of minority opinions in the schools, those with higher education were more favorable to the idea than those with less education. The difference in percentages between the elementary

* See original thesis on file, University of Wisconsin Library.

TABLE IX

STANDARD ERROR AND CRITICAL RATIO BETWEEN TWO PERCENTAGES FOR SELECTED ITEMS MADE BY RESPONDENTS OF DIFFERENT LEVELS OF EDUCATION

Description of Item	Elementary N = 146	Some High School N = 81	Finished High School N = 117	Differences in Percentage	Standard Error	Critical Ratio
1. Is education improving	80.82	72.83		8.00	5.91	1.35
	80.82		59.83	20.99	5.58	3.76
5. International problems	52.74	74.07		21.33	6.38	3.34
	52.74		71.79	19.05	5.86	3.25
6. School buildings	68.49	77.77		9.28	6.01	1.54
	68.49		82.05	13.56	5.23	2.59
12. Express minority opinion	50.00	62.96		12.96	6.77	1.91
	50.00		69.23	19.23	5.94	3.24
13. Character building	54.80	53.08		1.72	6.89	.25
	54.80		40.17	14.63	6.12	2.39
20. Denominational education	70.55	51.85		18.70	6.70	2.79
	70.55		43.59	26.96	5.93	4.55

group and those finishing high school was statistically significant with a critical ratio greater than 3.

For character building, one finds the elementary group placing greater stress on religion than on education, but for the group finishing high school greater stress was put on education. The differences between the percentages for this item did not reach the statistically significant level.

There existed a sharp difference of opinion between levels of education as to the merits of secular and denominational education. The lower educational group favored denominational schools by 70.55 per cent. The high educational group favored it by 40.59 per cent. The critical ratio was greater than 3.

Table X, entitled Responses to All Items Classified According to Social Status of the Respondent, lists responses of poor, average and wealthy for all 22 items. Following this table one finds Table XI, Responses in Percentages to Selected Items Classified According to Social Status of Respondent.

Social status tended to discriminate more than language, religion, sex, or age. The tables show to what extent the factors of wealth and social position determined differences in the opinions of respondents toward education. For item one, there was not too great a difference of opinion for the favorable response. The average and wealthy did not think that education has improved as much as did the poor group.

Attitudes toward the study of international problems were sharply differentiated between the 3 groups. For the poor group, 48.67 per cent believed that an increased emphasis should be put on a study of international problems, while for the wealthy group 77.59 per cent approved. Approximately the same ratio was expressed for a similar curriculum problem, that of permitting the expression of minority opinions. The poor approved by 50.00 per cent and the wealthy by 67.24 per cent.

In their attitudes toward character building, the poor group emphasized the value of church and religion to a greater extent than the wealthy group. The wealthy group believed in the greater influence of education as an important factor in character building.

Free education beyond high school was strongly favored by all classes but to a greater extent by the wealthy classes. The same was true of their approval of new and modern school buildings.

There was a slight tendency for the wealthy to more strongly approve free extensional educational opportunity beyond high school than for either of the other two groups. They likewise approved in greater numbers an increase in teachers' salaries. On the question, Should teachers' salaries be increased?, 58.66 per cent

TABLE X

RESPONSES TO ALL ITEMS CLASSIFIED ACCORDING TO SOCIAL STATUS OF THE RESPONDENT

	Poor			Average			Wealthy			Chi-Square	Level of Sign.
	N = 150			N = 136			N = 58				
Item	1 & 2	3	4 & 5	1 & 2	3	4 & 5	1 & 2	3	4 & 5		
1.	75.33	6.00	18.67	67.64	2.21	30.15	72.41	.00	27.59	10.01	.05
2.	85.33	8.00	6.67	89.71	2.21	8.09	93.10	3.44	3.44	6.81	*
3.	33.33	2.67	64.00	29.41	4.41	66.17	46.55	3.44	49.99	5.97	*
4.	80.67	9.33	10.00	86.03	5.15	8.83	87.93	.00	12.06		*
5.	48.67	10.00	41.33	75.74	5.15	19.12	77.59	.00	22.42	30.30	.01
6.	28.66	7.33	64.00	12.50	5.88	81.62	6.89	3.44	89.65	21.15	.01
7.	92.67	2.67	4.67	97.80	.74	1.48	96.55	3.44	.00		*
8.	89.34	5.33	5.33	94.12	.74	5.15	94.82	1.72	3.44		*
9.	84.66	9.33	6.00	88.97	6.62	4.41	89.65	8.62	1.72		*
10.	30.67	12.00	57.33	25.74	12.50	61.76	31.03	3.44	65.52	4.63	*
11.	88.67	2.67	8.67	88.97	4.41	6.62	91.37	1.72	6.88		*
12.	30.00	7.33	42.67	66.91	14.71	18.38	67.24	10.34	22.41	22.91	.01
13.	60.67	7.33	32.00	39.70	12.50	47.80	43.10	8.62	48.27	14.25	.01
14.	80.00	8.67	11.33	70.50	13.97	15.46	87.93	1.73	10.33	9.64	.05
15.	58.66	38.67	2.67	71.33	27.21	1.46	77.59	22.41	.00	9.50	.05
16.	77.33	14.67	8.00	82.35	13.97	3.68	86.21	10.34	3.44	4.04	*
17.	41.34	7.33	51.34	48.53	14.71	36.76	53.45	10.34	36.21	9.47	.05
18.	80.66	6.67	12.67	76.47	8.09	15.44	67.24	8.62	24.13	4.79	*
19.	93.34	2.00	4.67	92.65	2.94	4.41	96.55	.00	3.44		*
20.	67.33	8.00	24.67	53.67	16.91	29.41	37.92	18.97	43.11	16.66	.01
21.	52.01	30.67	17.33	55.15	6.62	38.23	60.34	15.52	24.13	34.84	.01
22.	38.00	5.38	56.67	39.71	6.62	53.68	44.82	3.44	51.73	1.48	*

** Refers to the various column responses to each item. For example, 75.33 per cent of the poor population indicated approval to item one, by responding in column one or two, 6.00 per cent indicated no opinion and 67.24 per cent indicated disapproval.

* Chi-Square was not at a statistically significant level.

of the poor group approved, 71.59 per cent of the average group approved, and 77.59 per cent of the wealthy group approved.

The average and wealthy groups more strongly approved new and modern school buildings than did the poor group. A sharp difference was noted between groups on their attitudes toward secular versus denominational education. The poor group favored denominational education by 67.33 per cent, the average by 53.67 per cent, and the wealthy by 37.92 per cent. The average and wealthy favored the election of school board members to a greater extent than did the poor group.

Table XII indicates which of the differences between percentages of the groups have a statistically significant difference. It will be noted that comparison was not made for the wealthy group in comparison with the other two groups for all of the items listed, because there were but 58 ballots for this group resulting in a high standard error. Likewise the percentage difference between the average group and the wealthy group was not significant.

Large differences in opinion at a statistically significant level were found between groups for several items. The two higher groups more strongly favored an increased study of international problems than did the poor group. This item differentiated with a critical ratio greater than 3 points. The above average groups favored a freer expression of minority opinions in the schools than did the poor group.

There were sharp differences of opinion between social status groups on the item concerning character building. The poor group favored church and religion as being of greater importance than school education in building character. The average and wealthy group put more emphasis on education. These same differences existed in attitudes towards denominational and secular education. In the poor group, denominational education was favored by 67.33 per cent, in the average group by 53.67, and in the wealthy by 39.92 per cent. These differences in percentages have a critical ratio of over 3.

TABLE XI

RESPONSES IN PERCENTAGES TO SELECTED ITEMS CLASSIFIED ACCORDING TO SOCIAL STATUS OF RESPONDENT

Type of Response to Items	Poor N = 150	Average N = 136	Wealthy N = 58	Chi-Square	Level of Signif.
1. Is education improving					
Yes	75.33	67.64	72.41	10.01	.05
No Opinion	6.00	2.21	.00		
No	18.67	30.15	27.59		
5. International problems					
Approve	48.67	75.74	77.59	30.30	.01
No Opinion	10.00	5.15	.00		
Disapprove	41.33	19.12	22.42		
6. School buildings					
Approve	28.66	82.62	89.63	21.15	.01
No Opinion	7.33	5.88	3.44		
Disapprove	64.00	12.50	6.89		
12. Express minority opinion					
Approve	50.00	66.91	67.24	22.91	.01
No Opinion	7.33	14.71	10.34		
Disapprove	42.67	18.38	22.41		
13. Character building					
Religion	60.67	39.70	43.10	14.25	.01
No Opinion	7.33	12.50	8.62		
Education	32.00	47.80	48.27		
14. Free education					
Approve	80.00	70.59	87.93	9.64	.05
No Opinion	8.67	13.97	1.73		
Disapprove	11.33	15.46	10.33		
15. Teachers' salaries					
Increase	58.66	71.33	77.59	9.50	.05
Remain low	38.67	27.21	22.41		
Decrease	2.67	1.46	.00		
17. New school buildings					
Approve	41.34	48.53	53.45	9.47	.05
No Opinion	7.33	14.71	10.34		
Disapprove	51.34	36.76	36.21		
20. Secular Education					
Approve	24.67	29.41	43.11	16.66	.01
No Opinion	8.00	16.91	18.97		
Disapprove	67.33	53.67	37.92		
21. School board					
Elected	52.01	55.15	60.34	34.84	.01
No Opinion	30.67	6.62	15.52		
Appointed	17.33	38.23	24.13		

* Chi-Square was not at a statistically significant level.

Table XIII indicates responses to all items classified in percentages according to religion of respondent. Table XIV indicates responses in percentages to selected items classified according to religion of respondent.

In this breakdown according to background factors one finds that a representative sample of Montreal according to census information consists of 78.20 per cent Catholic, 16.13 per cent Protestants, and 5.67 per cent Jews. In the sample studied, there are approximately the same percentages with no group deviating from the census information by as much as one per cent. The number of respondents for each group was as follows: Catholics—269, Protestants—57, and Jews—18. It is evident from the above information that Montreal is primarily a Catholic community.

One of the most interesting things to be observed in the item discriminating ability of this table is that there are less differences in percentages between the two major religious groups than there are between groups of different educational levels, or between groups which have different levels of social status. There were only eighteen ballots from the Jewish group in this sample and any large difference

TABLE XII

STANDARD ERROR AND CRITICAL RATIO BETWEEN TWO PERCENTAGES FOR SELECTED ITEM MADE BY RESPONDENTS OF DIFFERENT SOCIAL STATUS

Description of Item	Poor N = 150	Average N = 136	Wealthy N = 58	Difference in Percentage	Standard Error	Critical Ratio
5. International problems	48.67	75.74		27.07	5.48	4.94
6. School buildings	64.00	81.62		17.63	5.14	3.43
12. Express minority opinions	50.00	66.91		16.91	5.74	2,94
13. Character building	60.67	39.70		20.97	5.78	3.63
20. Denominational education	67.33 67.33	53.67	37.92	13.66 29.41	5.72 7.43	2.39 3.96

Comparisons were not made between poor and wealthy for all of the above items because the percentage difference between wealthy and average was not significant.

TABLE XIII

RESPONSES TO ALL ITEMS CLASSIFIED IN PERCENTAGES ACCORDING TO RELIGION OF RESPONDENT

	Catholics			Protestants			Jews			Chi-Square	Level of Signif.
	N = 269			N = 57			N = 18				
Item	1 & 2**	3	4 & 5	1 & 2	3	4 & 5	1 & 2	3	4 & 5		
1.	74.35	2.60	23.05	70.17	5.26	24.56	38.89	11.11	50.00	12.10	.05
2.	89.96	4.09	5.95	87.72	5.26	7.02	66.67	16.67	16.67	9.32	*
3.	30.11	3.72	66.17	50.87	3.51	45.61	38.89	.00	61.11	13.03	.05
4.	82.16	7.06	10.78	91.23	1.75	7.02	89.89	5.55	5.55		*
5.	61.71	6.69	31.60	75.43	5.26	19.30	66.66	5.55	27.78	4.49	*
6.	19.70	4.46	75.84	10.53	8.77	80.69	27.78	22.22	50.00	14.24	.01
7.	95.16	1.46	3.75	96.49	3.51	.00	94.45	5.55	.00		*
8.	92.56	2.97	4.46	87.71	3.51	8.77	100.00	.00	.00		*
9.	88.85	5.95	5.21	80.70	15.79	3.50	83.33	16.67	.00		*
10.	30.11	11.90	57.99	21.06	5.26	73.68	33.33	11.11	55.56	5.58	*
11.	86.99	4.09	8.92	96.49	.00	3.50	100.00	.00	.00	6.89	*
12.	57.25	10.41	32.34	68.42	14.03	17.55	66.66	5.55	27.78	5.65	*
13.	50.18	9.29	40.52	40.35	12.28	47.37	66.67	5.55	27.78	4.43	*
14.	78.07	10.78	11.15	75.44	5.26	19.30	77.78	5.55	16.66		*
15.	67.29	30.85	1.86	61.40	36.84	1.75	77.78	22.22	.00		*
16.	83.64	10.04	6.32	66.66	31.58	1.75	83.33	11.11	5.55	16.64	.01
17.	43.87	11.52	44.60	59.64	5.26	35.09	38.89	16.67	44.45	6.09	*
18.	78.07	5.20	16.72	73.68	14.03	12.28	66.66	22.22	11.11	11.46	.05
19.	92.56	2.23	5.20	96.49	1.75	1.75	100.00	.00	.00		*
20.	62.83	13.38	23.79	26.31	17.54	56.14	66.67	.00	33.33	31.15	.01
21.	49.81	19.33	30.86	73.68	14.03	12.28	66.67	22.22	11.11	14.14	.01
22.	38.66	5.58	55.76	42.10	7.02	50.87	50.00	.00	50.00		*

** Refers to the various column responses to each item. For example, 74.35 per cent of the Catholic population indicated approval to item one, by responding in column one or two, 2.60 per cent indicated no opinion, and 23.05 per cent indicated disapproval.

* Chi-Square was not at a statistically significant level.

TABLE XIV

RESPONSES IN PERCENTAGES TO SELECTED ITEMS CLASSIFIED ACCORDING TO RELIGION OF RESPONDENT

Type of Response to Item	Catholics N = 269	Protestants N = 57	Jews N = 18	Chi-Square	Level of Signif.
1. Is education improving					
Yes	74.35	70.17	38.89	12.10	.05
No Opinion	2.60	5.26	11.11		
No	23.05	24.56	50.00		
3. Physical punishment					
Approve	66.17	45.61	61.11	13.03	.05
No Opinion	3.72	3.51	.00		
Disapprove	30.11	50.87	38.89		
6. School buildings					
Approve	75.84	80.69	50.00	14.24	.01
No Opinion	4.46	8.77	22.22		
Disapprove	19.70	10.53	27.78		
12. Express minority opinion					
Approve	57.25	68.42	66.66	5.65	*
No Opinion	10.41	14.03	5.55		
Disapprove	32.34	17.55	27.78		
13. Character building					
Religion	50.18	40.35	66.67	4.43	*
No Opinion	9.29	12.28	5.55		
Education	40.52	47.37	27.78		
16. Provincial support					
Approve	83.64	66.66	83.33	16.64	.01
No Opinion	10.04	31.58	11.11		
Disapprove	6.32	1.75	5.55		
18. Religious education					
Increase or same	78.07	73.68	66.67	11.46	.05
No Opinion	5.20	14.03	22.22		
Decrease	16.72	12.28	11.11		
20. Secular education					
Approve	23.79	56.14	33.33	31.15	.01
No Opinion	13.38	17.54	.00		
Disapprove	62.83	26.31	66.67		
21. School board					
Elected	49.81	73.68	66.67	14.14	.01
No Opinion	19.33	14.03	22.22		
Appointed	30.86	12.28	11.11		

* Chi-Square was not at a statistically significant level.

between percentages of this group and the other two groups will not be statistically significant.

For item one, a higher percentage of respondents in the Catholic group considered education to be improving than was found among Protestant respondents. Catholics also approved of physical punishment for school children to a greater extent than Protestants. There was over twenty per cent difference in opinion response for this item.

Freer expression of minority opinion was favored to a greater extent by the Protestant group than by the Catholic. However, the difference was not statistically significant at .05 level according to the Chi-Square test.

For item thirteen, which poses the question of church versus education for character building, we find a slight tendency for Catholics to emphasize church to a greater extent than do Protestants. Catholics indicated preference for church on this item by 50.18 per cent. Protestants indicated preference for church by 40.35 per cent. The differences were not statistically significant at the .05 level. In item eighteen, which raises the question as to how much religious education should be taught in the schools, the differences of opinion between Catholics and Protestants were not very large. Apparently both Catholics and Protestants prefer the schools to place a strong emphasis on religious education. Not more than 16.72 per cent of the Catholics or 12.28 per cent of the Protestants wished to see less religious education in the schools.

Item sixteen differentiates significantly on the question of provincial support of education: 83.64 per cent of the Catholics approved of increased provincial support, while 66.66 per cent of the Protestants approved.

The sharpest difference of opinion and largest Chi-Square for any item on the ballot between Catholics and Protestants is secured from the question of secular versus denominational education. Catholics approve secular education by 23.79 per cent and Protestants approve secular education by 56.14 per cent.

For item twenty-one, which raises the question of electing or appointing school board members, we find Catholics favoring election of members by 49.81 per cent and Protestants favoring election by 73.68 per cent.

Further statistical analysis was made of differences between Catholics' and Protestants' attitudes towards education and it appears in Table XV.

The standard error and critical ratio was computed for several items to determine which of the differences in percentages were statistically significant. The Chi-Square test is designed to show any variation from the theoretical frequency for opinion variation. The standard error and critical ratio compare only two

TABLE XV

STANDARD ERROR AND CRITICAL RATIO BETWEEN TWO PERCENTAGES FOR SELECTED ITEMS MADE BY RESPONDENTS OF DIFFERENT RELIGIONS

Description of Item	Catholics N = 269	Protestants N = 57	Difference in Percentage	Standard Error	Critical Ratio
16. Provincial support	83.64	66.66	16.98	6.64	2.56
20. Denominational Education	62.83	26.31	36.52	6.58	5.55
21. School board	49.81	73.68	23.87	6.59	3.62

Comparisons were made on selected items between only Catholics and Protestants. No comparisons were made between these groups and Jews because only approximately 6.00 per cent of the Montreal population were of this group. This sample contained only eighteen ballots from Jews and any comparison made would not be statistically significant.

percentages at a time to determine the probability that differences are due to some factor other than chance.

Items twenty and twenty-one had percentage differences for Protestants and Catholics that were significantly different with a critical ratio of 3.0. On the denominational versus secular education, 62.83 per cent of the Catholics favored denominational education, and 23.31 per cent of the Protestants favored denominational education. Here we find a percentage difference of 36.52 per cent and a standard error of 6.58. This means that, in repeated samples, in about sixty-eight per cent of the samples the percentage difference between Catholics and Protestants would be 36.52 plus or minus 6.58 per cent.

The difference in percentage is divided by the standard error to obtain the critical ratio. If the critical ratio is three or more one can say that, in repeated samplings, there are more than 95 chances out of a hundred that one would not obtain this great a difference by chance fluctuation. That is, it seems to indicate that other factors have brought about the difference.

There is a statistically significant difference between the opinions of Catholics and Protestants on the question of electing school board members. Catholics favored electing school board members less frequently than Protestants, and the differences are statistically significant with a critical ratio of 3.62.

The next two tables, Tables XVI and XVII, consider item responses according to background factors of language. Montreal is primarily French and Catholic. In ascertaining language background three different groups were used. Group one could speak only French and numbered 89, Group two could speak only English and numbered 68, and Group three was bilingual or partially bilingual and numbered 187. The bilingual group is composed of both

French and English who have learned both languages.

Item one raised the question as to whether education is improving. Of the French group 88.77 per cent indicated "yes," of the English group 66.17 per cent indicated "yes," and of the bilingual group 65.77 per cent indicated "yes." Differences in these percentages were significant at the .05 level.

The English and bilingual approved the study of international problems to a slightly greater extent than did the French. The English group, in item ten, indicated greater willingness to support education than either the French or bilingual groups. This was also true of desire for increased dental and medical service.

TABLE XVI

RESPONSES TO ALL ITEMS IN PERCENTAGES CLASSIFIED ACCORDING TO LANGUAGE OF THE RESPONDENT

	French Only			English Only			Bilingual			Chi-Square	Level of Signif.
	N = 89			N = 68			N = 187				
Item	1 & 2**	3	4 & 5	1 & 2	3	4 & 5	1 & 2	3	4 & 5		
1.	88.77	1.12	10.11	66.17	5.88	27.93	65.77	3.74	30.48	10.31	.05
2.	92.14	5.62	2.25	82.35	5.88	11.76	88.77	4.28	6.95	6.02	*
3.	39.32	4.49	56.18	42.64	2.94	54.41	28.34	3.21	68.45	6.70	*
4.	79.77	6.74	13.48	89.71	.00	10.29	83.95	8.02	8.02	7.71	*
5.	53.93	11.24	34.88	70.58	2.94	26.47	66.84	5.35	27.81	8.20	*
6.	30.34	1.12	68.54	16.17	7.35	76.47	13.91	8.02	78.07	14.66	.01
7.	92.13	3.37	4.50	95.59	1.47	2.94	96.79	1.60	1.60		*
8.	89.88	3.37	6.74	91.17	2.94	5.88	93.58	2.67	3.74		*
9.	82.02	10.11	7.86	83.81	11.76	4.41	90.90	5.88	3.21		*
10.	37.07	10.11	52.81	14.70	7.35	77.94	29.94	12.30	57.75	12.60	.05
11.	82.02	5.62	12.36	95.58	.00	4.41	90.38	3.21	6.41	8.83	*
12.	48.31	6.74	44.94	66.18	8.82	24.99	62.56	13.37	24.07	14.83	.01
13.	57.30	11.24	31.46	38.23	8.82	52.94	49.73	9.09	41.18	7.52	*
14.	77.53	7.87	14.60	74.99	5.88	19.11	78.61	11.76	9.62		*
15.	62.92	31.46	5.62	63.23	36.76	.00	70.05	29.41	.53		*
16.	78.66	14.61	6.74	73.53	23.53	2.94	84.50	9.63	5.88	9.05	*
17.	49.43	6.74	43.82	61.76	7.35	30.88	39.04	13.90	47.06	12.67	.05
18.	87.64	6.74	5.62	69.11	17.65	13.23	74.33	4.28	21.39	23.57	.01
19.	91.01	3.37	5.61	97.05	1.47	1.47	93.59	1.60	4.81		*
20.	73.04	12.36	14.61	30.88	11.76	57.35	58.82	14.44	26.73	37.52	.01
21.	44.94	23.60	31.46	69.12	13.23	17.64	54.01	18.18	27.80	9.34	*
22.	35.96	5.62	58.43	41.17	4.41	54.41	41.18	5.88	52.94		*

** Refers to the various column responses to each item. For example, 88.77 per cent of the respondents having French only as a language thought that education was improving, 1.12 per cent indicate no opinion, and 10.11 per cent indicated "no" to this item.

* Chi-Square was not at a statistically significant level.

There was a sharper difference of opinion regarding expression of minority in the schools. Of the French group 48.31 per cent indicated "approve," of the English 66.18 per cent indicated "approve," and of the bilingual group 62.56 per cent indicated "approve."

There is some difference between opinion responses of the French, English, and bilingual group as to the influence of religion and education on character building. However these differences were not statistically significant at the .05 level according to the Chi-Square test.

The English group favored new school buildings more than do either the French or bilingual groups. To the question, "Do you think that new and modern school buildings result in better education?", 61.76 per cent of the English said "yes," 49.33 per cent of the French said "yes," and 39.04 per cent of the bilingual group said "yes."

The three groups differed in their opinions as to the amount of religion to be taught in the school. For the French group 87.64 per cent wanted an increase or the same religious education, 69.11 per cent of the English indicated the same response, while 74.33 per cent of the bilingual responded similarly. It was the French group that most strongly wanted the same or increased religious education.

TABLE XVII

RESPONSES IN PERCENTAGES TO SELECTED ITEMS CLASSIFIED ACCORDING TO LANGUAGE OF RESPONDENT

Type of Response to Item	French N = 89	English N = 68	Bilingual N = 187	Chi-Square	Level of Signif.
1. Is education improving					
Yes	88.77	66.17	65.77	10.31	.05
No Opinion	1.12	5.88	3.74		
No	10.11	27.93	30.48		
5. International problems					
Approve	53.93	70.58	66.84	8.20	*
No Opinion	11.24	2.94	5.35		
Disapprove	34.88	26.47	27.81		
10. School Support					
Approve	37.07	14.70	29.94	12.60	.05
No Opinion	10.11	7.35	12.30		
Disapprove	52.81	77.94	57.75		
11. Medical & dental service					
Approve	82.02	95.58	90.38	8.83	*
No Opinion	5.62	.00	3.21		
Disapprove	12.36	4.41	6.41		
12. Express minority opinion					
Approve	48.31	66.18	62.56	14.83	.01
No Opinion	6.74	8.82	13.37		
Disapprove	44.94	24.99	24.07		
13. Character building					
Religion	57.30	38.23	49.73	7.52	*
No Opinion	11.24	8.82	9.09		
Education	31.46	52.94	41.18		
17. New School buildings					
Approve	49.43	61.76	39.04	12.67	.05
No Opinion	6.74	7.35	13.90		
Disapprove	43.82	30.88	47.06		
18. Religious education					
Increase or same	87.64	69.11	74.33	23.57	.01
No Opinion	6.74	17.65	4.28		
Decrease	5.62	13.23	21.39		
20. Secular education					
Approve	14.61	57.35	26.73	37.52	.01
No Opinion	12.36	11.76	14.44		
Disapprove	73.04	30.88	58.82		

* Chi-Square was not at a statistically significant level.

TABLE XVIII

STANDARD ERROR AND CRITICAL RATIO BETWEEN TWO PERCENTAGES FOR SELECTED ITEMS MADE BY RESPONDENTS OF DIFFERENT LANGUAGES

Description of Item	French N = 89	English N = 68	Bilingual N = 187	Difference in Percentage	Standard Error	Critical Ratio
6. School buildings	68.54	76.47		7.93	7.51	1.06
	68.54		78.07	9.53	6.24	1.53
12. Express minority opinion	48.31	66.18		17.77	7.81	2.28
	48.31		62.56	14.25	6.37	2.24
18. Religious education	87.64	69.67		18.53	6.67	2.78
	87.64		74.33	10.31	4.73	2.18
20. Denominational education	73.04	30.88		42.16	7.31	5.77
	73.04		58.82	14.22	5.91	2.41

There were sharp differences between language groups on the question of secular versus denominational education. Various groups responded as follows for approval of denominational education: French—73.04 per cent, English—30.88 per cent, and bilingual—58.82 per cent. Thus we can see that the French prefer denominational education and the majority of the English prefer secular education. Table XVIII compares those items which have large percentage differences to determine whether the difference between two percentages are statistically significant. This table has few items with a critical ratio of over 3 point because the standard error tends to be large. This is due to the relatively small number of cases for both French and English groups in contrast to the bilingual group.

On the question of expressing minority opinions as raised by item twelve, the English and bilingual group more strongly "approve" than the French.

The biggest difference between the three language groups was found in item twenty, which raises the question of denominational versus secular education. The French favored denominational education by 73.04 per cent, and the English approve denominational education by 30.88 per cent. This difference in percentage is statistically significant with a critical ratio greater than 3.0.

Table XIX indicates response to all items in percentages classified according to the sex of the respondent and Table XX indicates responses to selected items in percentages classified according to the sex of the respondent.

Opinions of men and women do not differ as much as do other background factors such as education, social status, religion, or language. The Chi-Square for this table could be smaller and still be statistically significant at the .01 or .05 level because there are only two degrees of freedom.

For item five, men indicated in greater numbers than women that they favored increased emphasis on the study of international problems in schools. While the "disapprove" responses for both sexes were about the same, a larger number of women indicated no opinion to this item. Item five differentiated at the .05 level according to the Chi-Square test.

Women favored an increased emphasis being placed on extra-curricular activities, while men more strongly favored increased emphasis on industrial education.

The differences between men and women were of interest on item thirteen, which raised the question whether church and religion were of more importance than education in building character. For this item, 52.02 per cent of the male respondents checked "religion," while 46.79 per cent of the female respondents checked "religion." In further comparison of the "no opinion" and "education" responses on this item, it is evident that men believe that the school is of less influence in building character than do women.

Item seventeen, which raises the question whether new or modern school buildings result in better education, was responded to as follows: 52.60 per cent of the men indicated "approve," while 39.77 per cent of the women indicated "approve." For item twenty-one which raises the question of electing or appointing school board members, men favored electing by 58.39 per cent while women favored electing by 50.88 per cent.

Table XXI indicates the standard error and critical ratio between two percentages for items five and seventeen made by men and women. An analysis of this table shows that while statistically significant differences were achieved for six items in Table XX according to Chi-Square test, which took into consideration three different responses for each item, none of the items in Table XXI differentiate with a critical ratio above the 3 point level. Thus while the percentage differences appear large they are not three times the standard error.

Table XXII indicates responses to all items in percentages classified according to the age of the respondent. This table tends to discriminate less than any of the other background factors studied.

Table XXIII indicates responses to selected items classified according to the age of the respondent. For this table we have only four items which discriminate at the .05 or .01 level according to the Chi-Square test.

For item one which raises the question whether education is improving, we find the following "yes" response for different age groups: for the 18-29 year group, 66.10 per cent; for the 30-49 year group, 72.15 per cent; and for the 50 years and over group, 80.88 per cent. In other words the older group tended to think that education has improved more since they were in school than did the younger group. These differences, however, were not at a statistically significant level.

TABLE XIX

RESPONSES TO ALL ITEMS IN PERCENTAGES CLASSIFIED ACCORDING TO SEX OF RESPONDENT

	Men			Women			Chi-Square	Level of Signif.
	N = 173			N = 171				
Item	1 & 2**	3	4 & 5	1 & 2	3	4 & 5		
1.	73.41	2.89	23.69	70.17	4.09	25.73		*
2.	87.86	6.36	5.78	88.89	3.51	7.60		*
3.	35.26	6.36	58.38	32.75	.58	66.66		*
4.	85.55	6.36	8.09	82.45	5.85	11.70		*
5.	67.63	2.89	29.48	60.82	9.94	29.24	10.12	.01
6.	16.76	8.09	75.15	20.47	4.09	75.44	2.89	*
7.	95.95	1.16	2.89	94.74	2.92	2.33		*
8.	89.02	4.05	6.94	95.33	1.75	2.92	4.72	.05
9.	90.18	4.62	5.20	84.21	11.70	4.09	5.86	.05
10.	32.27	8.67	58.96	25.15	12.87	61.99	3.09	*
11.	89.59	3.47	6.94	88.89	2.92	8.18		*
12.	61.28	10.40	28.33	57.89	11.11	30.99	.40	*
13.	52.02	12.14	35.83	46.79	7.02	46.20	5.09	.05
14.	79.78	8.67	11.56	75.44	10.53	14.04	.92	*
15.	67.05	31.21	1.74	66.67	31.58	1.75		*
16.	86.13	9.25	4.62	75.44	18.13	6.43		*
17.	52.60	12.72	34.68	39.77	8.77	51.46	9.93	.01
18.	77.46	7.51	15.05	76.02	7.60	16.37		*
19.	93.06	1.16	5.78	94.16	2.92	2.92		*
20.	57.22	13.87	28.90	56.72	12.87	30.41		*
21.	58.39	14.45	27.17	50.88	22.81	26.32	4.15	.05
22.	42.19	6.94	50.86	37.43	4.09	58.48		*

** Refers to the various column responses to each item. For example, 73.41 per cent of the men indicated approval to item one, by responding in column one or two.

* Chi-Square was not at a statistically significant level.

TABLE XX

RESPONSES TO SELECTED ITEMS IN PERCENTAGES CLASSIFIED ACCORDING TO SEX OF THE RESPONDENT

Type of Response to Item	Men N = 173	Women N = 171	Chi-Square	Level of Signif.
5. International problems				
Approve	67.63	60.82	10.12	.01
No Opinion	2.89	9.94		
Disapprove	29.48	29.24		
8. Extra-curricular Activities				
Approve	89.02	95.33	4.72	.05
No Opinion	4.05	1.75		
Disapprove	6.94	2.92		
9. Industrial education				
Approve	90.18	84.21	5.86	.05
No Opinion	4.62	11.70		
Disapprove	5.20	4.09		
13. Character building				
Religion	52.02	46.79	5.09	.05
No Opinion	12.14	7.02		
Education	35.83	46.20		
17. New school buildings				
Approve	52.60	39.77	9.93	.01
No Opinion	12.72	8.77		
Disapprove	34.68	51.46		
21. School board				
Elected	58.39	50.88	4.15	.05
No Opinion	14.45	22.81		
Appointed	27.17	26.32		

TABLE XXI

STANDARD ERROR AND CRITICAL RATIO BETWEEN TWO PERCENTAGES FOR SELECTED ITEMS MADE BY MEN AND WOMEN

Description of Item	Men N = 173	Women N = 171	Differences in Percentage	Standard Error	Critical Ratio
5. International problems	67.63	60.82	6.81	5.15	1.32
17. New school buildings	52.60	39.77	12.83	5.33	2.41

The younger groups tended to favor an increased emphasis on the study of both national and international problems in social science courses more than the older groups. Both items four and five which deal with this problem differentiate at a statistically significant level. Respondents' opinions for item five stressing the study of international problems were as follows: the younger group "approved" by 76.27 per cent, the middle group by 60.13 per cent and older group by 52.94 per cent. This same pattern of response was repeated in item twelve which raised the question of expressing minority opinions. The younger group tended to want all sides of questions discussed in the school to a greater extent than did the older group. This item does not differentiate at the .01 or .05 level.

TABLE XXII

RESPONSES TO ALL ITEMS IN PERCENTAGES CLASSIFIED ACCORDING TO AGE OF THE RESPONDENT

	18-29 Years			30-49 Years			50 Years & Over			Chi-Square	Level of Signif.
	N = 118			N = 158			N = 68				
Item	1 & 2**	3	4 & 5	1 & 2	3	4 & 5	1 & 2	3	4 & 5		
1.	66.10	4.24	29.66	72.15	3.16	24.68	80.88	2.95	16.17	4.57	*
2.	92.37	3.39	4.23	89.87	3.80	6.33	77.93	10.29	11.76		*
3.	27.97	3.39	68.65	37.70	5.06	58.23	38.24	.00	71.77	8.81	*
4.	91.53	5.08	3.39	82.91	6.33	10.76	73.53	7.53	19.12	12.50	.05
5.	76.27	2.54	21.19	60.13	7.59	32.28	52.94	10.29	36.77	14.01	.01
6.	16.10	6.78	77.12	17.72	4.43	77.84	25.00	8.82	66.18	4.54	*
7.	94.91	3.39	1.69	97.47	.00	2.54	91.17	4.41	4.41		*
8.	96.61	1.69	1.69	91.14	3.16	5.69	86.76	4.41	8.82	6.41	*
9.	87.29	8.47	4.24	83.44	9.49	5.07	91.18	4.41	4.41		*
10.	27.96	12.71	59.32	24.68	10.13	65.19	39.70	8.82	51.47		*
11.	89.83	3.39	6.78	87.97	3.16	8.96	91.18	2.94	5.88		*
12.	67.79	10.17	22.04	58.23	9.49	32.28	48.53	14.71	36.77	7.89	*
13.	44.92	14.41	40.68	48.73	6.33	44.94	58.82	8.82	32.36	8.22	*
14.	68.64	17.80	13.56	84.81	3.80	11.39	76.47	8.82	14.70	15.59	.01
15.	64.41	33.05	2.54	60.76	37.34	1.90	85.29	14.71	.00	13.42	.01
16.	79.66	15.25	5.08	77.84	15.19	6.97	89.70	7.35	2.94	4.64	*
17.	41.52	11.02	47.46	45.57	12.03	42.40	55.88	7.35	36.77	4.09	*
18.	81.36	5.08	13.56	74.05	6.96	18.98	75.00	13.24	11.76		*
19.	90.68	4.24	5.09	94.93	.63	4.43	95.59	1.47	2.94		*
20.	56.77	8.47	34.74	55.07	15.82	29.11	61.76	16.18	22.06		*
21.	49.15	22.88	27.97	60.76	13.29	25.95	50.00	23.53	26.47		*
22.	40.67	4.24	55.08	34.17	6.33	59.50	51.48	5.88	42.65	6.61	*

** Refers to the various column responses to each item. For example, 66.10 per cent of the French population indicated approval to item one, by responding in column one or two.

* Chi-Square was not at a statistically significant level.

TABLE XXIII

RESPONSES IN PERCENTAGES TO SELECTED ITEMS CLASSIFIED ACCORDING TO AGE OF RESPONDENT

Type of Response to Item	18-29 Yrs. N = 118	30-49 Yrs. N = 158	50 Yrs. and Over N = 68	Chi-Square	Level of Signif.
1. Is education improving					
Yes	66.10	72.15	80.88	4.57	*
No Opinion	4.24	3.16	2.94		
No	29.66	24.68	16.17		
4. National problems					
Approve	91.53	82.91	73.55	12.50	.05
No Opinion	5.08	6.33	7.53		
Disapprove	3.39	10.76	19.12		
5. International problems					
Approve	76.27	60.13	52.94	32.24	.01
No Opinion	2.54	7.59	10.29		
Disapprove	21.19	32.28	36.77		
12. Express minority opinion					
Approve	67.79	58.23	48.53	7.89	*
No Opinion	10.17	9.49	14.71		
Disapprove	22.04	32.28	36.77		
13. Character building					
Religion	44.92	48.73	58.82	8.22	*
No Opinion	14.41	6.33	8.82		
Education	40.68	44.94	32.36		
14. Free education					
Approve	68.64	84.81	76.47	15.59	.01
No Opinion	17.80	3.80	8.82		
Disapprove	13.56	11.39	14.70		
15. Teachers' Salaries					
Increase	64.41	60.76	85.29	13.42	.01
Remain low	33.05	37.34	14.71		
Decrease	2.54	1.90	.00		

* Chi-Square was not at a statistically significant level.

Item thirteen, which emphasizes various aspects of character building, does not differentiate at a significant level; however, the older groups had greater confidence in the values of religion for character building than did the younger groups.

Items fourteen and fifteen, which have to deal with free education beyond high school and teachers' salaries in Montreal, show an interesting pattern. For item fourteen the middle group more firmly believed in free education beyond high school than either the younger or older groups. On item fifteen, when respondents were asked whether teachers' salaries be increased, remain the same, or decreased, it is the middle group which was most hesitant to increase teachers' salaries. The fact that most of the responsibility for additional tax funds would be placed on the middle group may account for their hesitancy in recommending increases.

Table XXIV indicates the standard error and critical ratio between two percentages of responses to selected items made by persons of different ages. Three of the items discriminated with a critical ratio three times the standard error.

For item five, there were large differences in the percentages for each group in their responses for the study of international problems. The younger groups believed strongly that an increased emphasis should be made in that direction. The older persons were less sure on this item.

There was a statistically significant difference betwen opinions of the 18-29 year group and the 30-49 year group, as to whether education should be more free.

The younger group approved of freer education by 68.64 per cent, the middle group by 84.81 per cent. Probably the middle group had sufficient time to become aware of the lack of

TABLE XXIV

STANDARD ERROR AND CRITICAL RATIO BETWEEN TWO PERCENTAGES FOR SELECTED ITEMS MADE BY PERSONS OF DIFFERENT AGES

Description of Item	18-29 Years N = 118	30-49 Years N = 158	50 Yrs. and Over N = 68	Difference in Percentage	Standard Error	Critical Ratio
5. International problems	76.27	60.13		16.14	5.52	2.94
	76.27		52.94	23.33	7.21	3.24
14. Free education	68.64	84.81		16.17	5.13	3.15
	68.64		76.47	7.83	6.67	1.17
15. Teachers' salaries	64.41	60.76		3.65	5.87	.62
	64.41		85.29	20.88	6.15	3.40

educational opportunities that existed beyond high school which the younger group did not feel at their age.

To the question as to whether teachers' salaries should be increased, 85.29 per cent of the older group indicated approval, 60.76 per cent of the middle group, and 64.41 of the younger group.

Table XXV compares the four background factors which are significant according to the Chi-Square test for item one. It is evident that the French group had the greatest confidence that education is improving. Catholics likewise saw greater improvement in education than Protestants or Jews. The poor group according to social status saw greater improvement than average or wealthy. Those respondents who were in the elementary school group saw greater improvement in education than respondents having some high school or the group that had finished high school.

TABLE XXV

COMPARISON OF FAVORABLE RESPONSES TO ITEM ONE CLASSIFIED ACCORDING TO SELECTED BACKGROUND FACTORS

Item One. Do you think that children today get a better education than you received?
(Yes Response)

Background Factors	Percentage
Total favorable responses	71.80
Language	
French	88.77
English	66.17
Bilingual	65.77
Religion	
Catholics	74.35
Protestants	70.17
Jews	38.89
Social Status	
Poor	75.33
Average	67.64
Rich	72.41
Education	
Elementary	80.82
Some High School	72.83
Fin. High School	59.83

Background factors used have a Chi-Square at the .05 or .01 level.

From Table XXVI one can see that more men than women placed value on a study of international relations more than did the middle or older groups, and English groups more than the French or bilingual groups.

Item 5 differentiated in social status and education in the following manner: the average and wealthy group wanted greater stress placed on the study of international relations than did the poor group, and the two higher educational groups more strongly approved than did the elementary group.

TABLE XXVI

COMPARISON OF FAVORABLE RESPONSES TO ITEM FIVE CLASSIFIED ACCORDING TO SELECTED BACKGROUND FACTORS

Item Five. Some say that subjects such as democracy, communism, imperialism, and international relations should be discussed in the schools. Do you agree or disagree?
(Approve Response)

Background Factors	Percentage
Total favorable responses	64.25
Sex	
Men	67.63
Women	60.81

Age	
18-29 years	76.27
30-49 years	60.13
50 years and over	52.94
Language	
French	53.93
English	70.58
Bilingual	66.84
Social Status	
Poor	48.67
Average	75.74
Wealthy	77.59
Education	
Elementary	52.74
Some High School	74.07
Fin. High School	71.79

Background factors used have a Chi-Square at the .05 or .01 level.

Table XXVII shows a breakdown of background factors for item six. The poor group more than the average or wealthy group felt children tend to become dissatisfied with their homes if they attend new and modern school buildings. Those respondents having elementary education were likewise less confident of the influence of school buildings. Catholics to a small extent more than Protestants were convinced as to the desirable educational results of new school buildings.

TABLE XXVII

COMPARISON OF FAVORABLE RESPONSES TO ITEM SIX CLASSIFIED ACCORDING TO SELECTED BACKGROUND FACTORS

Item Six. If school buildings are new and modern do you think that children will become dissatisfied with their homes?
(No Response)

Background Factors	Percentage
Total favorable responses	75.59
Social Status	
Poor	64.00
Average	82.62
Wealthy	89.65
Education	
Elementary	68.49
Some High School	77.77
Fin. High School	82.05
Religion	
Catholics	75.84
Protestants	80.69
Jews	50.00

Background factors used have a Chi-Square at the .05 or .01 level.

Table XXVIII, which compares background factors for item twelve, has only two groups which differentiated at a significant Chi-Square level. The wealthy and the average groups more than the poor wished expression of minority opinion in the schools. The two higher educational groups more than the elementary group likewise wished minority opinions expressed.

TABLE XXVIII

COMPARISON OF FAVORABLE RESPONSES TO ITEM TWELVE CLASSIFIED ACCORDING TO SELECTED BACKGROUND FACTORS

Item Twelve. Should speakers who might have different views from the majority of people in the community be permitted to speak at high school assembly programs?
(Yes Response)

Background Factors	Percentage
Total favorable responses	59.60
Social Status	
Poor	50.00
Average	66.91
Wealthy	67.24
Education	
Elementary	50.00
Some High School	62.96
Fin. High School	69.23

Background factors used have a Chi-Square at the .05 or .01 level.

Table XXIX compares background factors that are statistically significant for item thirteen. Women had greater confidence than men that education is an important factor in building character. The farther one goes up the scale in social status, the greater confidence expressed in education. There appears to be no direct relationship on this question between the amount of education and opinion response.

TABLE XXIX

COMPARISON OF FAVORABLE RESPONSES TOWARD EDUCATION ON ITEM THIRTEEN CLASSIFIED ACCORDING TO SELECTED BACKGROUND FACTORS

Item Thirteen. Do you think that church and religion are more important than school education in building character?
(No Response)

Background Factors	Percentage
Total favorable responses	40.99
Sex	
Men	35.83
Women	46.20
Social Status	
Poor	32.00
Average	47.80
Wealthy	48.27

Education	
Elementary	40.41
Some High School	34.57
Fin. High School	46.15

Background factors used have a Chi-Square at the .05 or .01 level.

Table XXXI compares background factors for item twenty. There was a sharp opinion between language groups on this item. The English were more strongly in favor of secular education than the French or bilingual groups.

The higher groups in social status favored secular education to a greater extent than did the lower two groups. The group which finished high school favored secular education more strongly than the elementary group.

Table XXX shows the comparison of background factors for item seventeen.

Men apparently had greater confidence in the value of new school buildings than did women. The English group appeared to value new school buildings more than did the French or bilingual groups, and those who finished high school more than the other two groups. The higher the social status, the stronger was the opinion for new school buildings.

TABLE XXX

COMPARISON OF FAVORABLE RESPONSES TO ITEM SEVENTEEN CLASSIFIED ACCORDING TO SELECTED BACKGROUND FACTORS

Item Seventeen. Do you think that children generally get a better education in new and modern school buildings?

(Yes Response)

Background Factors	Percentage
Total favorable responses	46.22
Sex	
Men	52.60
Women	39.77
Language	
French	49.43
English	61.76
Bilingual	39.04
Education	
Elementary	43.15
Some High School	41.97
Fin. High School	52.99
Social Status	
Poor	41.34
Average	48.53
Wealthy	53.45

Background factors used have a Chi-Square at the .05 or .01 level.

TABLE XXXI

COMPARISON OF RESPONSES TOWARD SECULAR EDUCATION ON ITEM TWENTY ACCORDING TO SELECTED BACKGROUND FACTORS

Item Twenty. Some provinces have non-denominational schools, while others have Catholic and Protestant schools. Which school system helps national unity most?

(Secular Education Response)

Background Factors	Percentage
Total favorable responses	29.65
Language	
French	14.61
English	57.35
Bilingual	26.71
Social Status	
Poor	24.67
Average	29.41
Wealthy	43.11
Education	
Elementary	20.54
Some High School	30.86
Fin. High School	40.18
Religion	
Catholics	23.79
Protestants	56.14
Jews	33.33

Background factors used have a Chi-Square at the .05 or .01 level.

There was sharp difference of opinion between Catholics and Protestants as to secular education.

Table XXXII compares background factors for item twenty-one. Men advocated the election of school board members more than did women. The average and wealthy groups favored election of school board members more than did the poor group. The two higher educational groups favored electing of school board members more than did the elementary group. Protestants favored election more than did Catholics.

TABLE XXXII

COMPARISON OF RESPONSE TOWARD ELECTING OF SCHOOL BOARD MEMBERS ON ITEM TWENTY-ONE

ACCORDING TO SELECTED BACKGROUND FACTORS

Item Twenty-one. Do you think that school board members should be elected by residents of the school district or should they be appointed by the Quebec Board of Education?

(Elected Response)

Background Factors	Percentage
Total favorable responses	54.65
Sex	
Men	58.39
Women	50.88

Social Status	
Poor	52.01
Average	55.15
Wealthy	60.34
Education	
Elementary	47.94
Some High School	62.96
Fin. High School	57.26
Religion	
Catholics	49.81
Protestants	73.68
Jews	66.67

Background factors used have a Chi-Square at the .05 or .01 level.

Chapter V

Summarization Conclusions and Implications For Further Research

The problem of this chapter is to bring together in a concise manner the results of the investigation discussed elsewhere in this report. Opinion responses for the entire population will first be discussed, and then an analysis will be made according to background factors.

Summarization of Responses for Entire Population

1. More than two persons out of three were of the opinion that education in Montreal is improving.
2. Montreal citizens desired an increased curricular emphasis on the study of national and international problems.
3. Strong approval was given to increased emphasis on the physical culture, athletics, extra-curricular activities, opportunity for industrial education, and medical and dental services.
4. Respondents approved, but not in large numbers, the expression of minority opinions in schools.
5. Opinion was about evenly divided as to whether new school buildings result in better education.
6. Approximately two-thirds of the respondents indicated "approval" of increasing teachers' salaries and approximately one-third thought they should remain the same.
7. Strong approval was given to the increase of free education.
8. Approximately three out of four respondents desired the same or increased religious education in the schools.
9. On the question of secular versus religious education, approximately 30 per cent of the respondents favored secular, 13 per cent had no opinion, and 57 per cent favored denominational education.
10. Opinion was divided regarding the election or appointment of school board members. Approximately 55 per cent of the respondents favored the election of school board members, 18 per cent had no opinion, and 27 per cent favored their appointment.
11. Opinion was divided as to whether the school curriculum should be adjusted to meet the needs of all pupils or should maintain the present standards. Approximately 65 per cent of the respondents approved adjusting the school offering, 5 per cent had no opinion, and 40 per cent approved of maintaining present standards.

Summarization of Opinion by Respondents of Different Educational Levels

All of the items on the interview schedule did not differentiate for each background factor. Consequently, only those questions will be discussed where a significant difference in opinion was found.

1. The lower groups in educational attainment were most firmly convinced that education has been improving since they have been in school. The high school graduates were least thoroughly convinced that education is improving.
2. High school graduates believed more strongly than those who had attended elementary school only that increased emphasis should be put on the study of international problems.
3. The higher educational groups believed more strongly in permitting the expression of minority opinion in the schools.
4. Opinion was rather evenly divided regarding the respective values of religion or education for character building. Respondents who had attended elementary school only

checked religion in greater proportions. Respondents who finished high school checked education in greater numbers.

5. High school graduates approved new school buildings in greater numbers than did the elementary school group.

6. High school graduates approved of secular education in greater numbers than did the elementary school group.

7. High school graduates approved of electing school board members in greater numbers than did the elementary school group.

Summarization of Opinion by Respondents of Different Social Status

1. The poor group was more firmly convinced that education has improved than did the wealthy group.

2. The wealthy group believed more strongly in the study of international problems than did the poor group.

3. The wealthy group approved of new school buildings to a greater extent than did the poor group.

4. The poor group believed more strongly in denominational education, while the wealthy group preferred secular education.

5. For character building, the poor group placed greater value on religion than on education, whereas the average and wealthy groups placed greater value upon education.

6. The average and wealthy groups approved increased teachers' salaries in greater numbers than did the poor group.

7. The average and wealthy groups believed more strongly than the poor group in the election of school board members.

Summarization of Opinion by Respondents of Different Religions

1. More Catholics believed that education has improved than did Protestants or Jews.

2. More Catholics approved of physical punishment for school children than did Protestants or Jews.

3. Protestants approved more strongly than Catholics of the expression of the opinions of minority groups in the school.

4. For character building, Catholics saw greater value in religion, whereas Protestants saw greater value in education. The differences, however, were not significant.

5. All three groups, Protestants, Catholics, and Jews, strongly approved religious education in the schools.

6. Protestants believed more strongly in secular education whereas Catholics believed more strongly in denominational education.

7. Protestants in larger numbers believed in the election of school board members.

Summarization of Opinion by Respondents of Different Ages

1. Older people believed, more than did younger people, that education is improving.

2. Younger people believed more than older people that increased emphasis should be placed on the study of national and international problems.

3. Younger people gave stronger approval of the expression of minority opinions in the schools.

4. For character building older people placed greater value on religious training than did younger people.

5. Older people believed in increased teachers' salaries in larger numbers than did younger people.

Summarization of Opinions by Respondents of Different Language Groups

1. The French speaking group believed that education is improving more than did the English speaking or bilingual groups.

2. Respondents in the English and bilingual groups approved the study of international problems in greater numbers than did the French group.

3. Respondents in the English and bilingual groups approved the expression of minority opinion in greater number than did the French group.

4. The English group approved of new school buildings in greater number than did the French or bilingual groups.

5. The French group believed in a stronger emphasis on religious education than did the English or bilingual groups.

6. The French group approved denominational education whereas a majority of the English group preferred secular education.

Summarization of Opinions by Men and Women

1. More men believed in a study of international problems than did women.
2. More women approved of extra-curricular activities in the schools than did men.
3. More men approved of an increased emphasis on industrial education than did women.
4. More men approved of new school buildings than did women.
5. More men believed in the election of school board members than did women.

Conclusions

It is significant that background factors such as education and social status resulted in a greater differentiation of opinion responses than did the relatively inflexible determinants such as sex, age, or religion. This observation gives encouragement to those in positions of leadership who are trying to bring about changes in aims, methods and organization of education. Older people and younger people are more alike than different in their attitudes toward education. The differences of opinion toward education between Catholics and Protestants were not as great as among respondents of different levels of educational background. When the discussion was kept in terms of objectives to be achieved in education, the goals of Protestants and Catholics were very nearly alike.

There are many problems in school organization and support where there were sharp differences of opinion, but, when questions of general objectives were raised, there was much greater unanimity of opinion than there were differences.

Implications for Further Research

There are many studies which could be made using the cross section sampling method of public opinion measurement. The following three suggested studies serve only to illustrate the application of this method of research.

1. Measurement of the attitudes of the lay public in three small cities which have small high schools to determine curriculum content, extension of educational services, and the type of school experiences desired by the residents of the community. An attempt could be made to get a cross section of community opinion giving further understanding to the problem facing the small high school.

2. Measurement of the attitudes of farmers and village inhabitants to the problem of rural school consolidation and reorganization. A study could be made in three or more districts: In district one, where school consolidation has been accomplished; in district two, where the issue is at present controversial; and in district three, where the problem has not been seriously considered. This suggested study could use the non-directive interviewing technique used extensively by the Department of Agriculture in getting opinions from farmers.

3. An investigation could be made comparing lay social and educational attitudes in three cities from 10,000 to 50,000 population. This type of study could determine whether there was any relationship between the social and the educational attitudes of the public.

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APPENDIX "A"

English Ballot

EDUCATIONAL ATTITUDES IN MONTREAL

1. Do you think that children today get a better education than you received?
(1) Yes. (2) Yes. (3) No opinion. (4) No. (5) No.

Comment _____( )

2. Do you approve or disapprove of new ideas and experimentation in education?
(1) Approve. (2) Approve. (3) No opinion. (4) Disapprove. (5) Disapprove.

Comment _____( )

3. Do you approve or disapprove of physical punishment for pupils who have misbehaved?
(1) Approve. (2) Approve. (3) No opinion. (4) Disapprove. (5) Disapprove.

Comment _____( )

4. Some say that high school studies should emphasize present day problems like housing, crime, national unity, safety. Do you approve or disapprove?
(1) Approve. (2) Approve. (3) No opinion. (4) Disapprove. (5) Disapprove.

Comment _____( )

5. Some say that subjects such as democracy, communism, imperialism and international relations should be discussed in the schools. Do you think they should be discussed or not discussed?
(1) Discussed. (2) Discussed. (3) No opinion. (4) Not discussed. (5) Not discussed.

Comment _____( )

6. If school buildings are new and modern, do you think that children will become dissatisfied with their homes?
(1) Yes. (2) Yes. (3) No opinion. (4) No. (5) No.

Comment _____( )

7. Do you approve or disapprove of having the high school stress athletics and physical culture as a part of the school program?
(1) Approve. (2) Approve. (3) No opinion. (4) Disapprove. (5) Disapprove.

Comment _____( )

8. Do you approve or disapprove of high schools stressing extra-curricular activities such as debating, clubs, and school papers?
(1) Approve. (2) Approve. (3) No opinion. (4) Disapprove. (5) Disapprove.

Comment _____( )

9. Should school boards spend more money to train students and adults in art and trade schools for skilled industrial jobs?
(1) Yes. (2) Yes. (3) No opinion. (4) No. (5) No.

Comment _____( )

10. Some say that changes in the school program are not justified if they cost more money. Do you agree or disagree?
(1) Agree. (2) Agree. (3) No opinion. (4) Disagree. (5) Disagree.

Comment _____( )

11. Do you approve or disapprove of the idea that the schools should spend money for medical and dental examinations for all children?
(1) Approve. (2) Approve. (3) No opinion. (4) Disapprove. (5) Disapprove.

Comment _____( )

12. Should speakers who might have different views from the majority of people in the community be permitted to speak at high school assembly programs?
(1) Should speak. (2) Should speak. (3) No opinion. (4) Not speak. (5) Not speak.

Comment _____( )

13. Do you think that church and religion are more important than school education in building character?
(1) Yes. (2) Yes. (3) No opinion. (4) No. (5) No.

Comment _____( )

14. Do you think students beyond high school who want further education should have the opportunity to get it free, or should they pay for it themselves?
(1) Free. (2) Free. (3) No opinion. (4) Pay. (5) Pay.

Comment _____( )

15. Should teachers' salaries in Montreal be increased, remain the same, or be decreased?
(1) Increased. (2) Increased, (3) No opinion. (4) Decreased. (5) Decreased.

Comment _____( )

16. The provincial government should pay for a larger share of the Montreal school budget. Do you agree or disagree?
(1) Agree. (2) Agree. (3) No opinion. (4) Disagree. (5) Disagree.

Comment _____( )

17. Do you think that children generally get a better education in new and modern school buildings?
(1) Yes. (2) Yes. (3) No opinion. (4) No. (5) No.

Comment _____( )

18. How much time do you think should be devoted to religious instruction — more than at present, about the same, less than at present, or none at all?
(1) More. (2) About the same. (3) No opinion. (4) Less. (5) None.

Comment _____( )

19. Do you think that vocational guidance should be given to all pupils as part of the school program?
(1) Yes. (2) Yes. (3) No opinion. (4) No. (5) No.

Comment _____( )

20. Some provinces have non-denominational schools, while others have Catholic and Protestant schools. Which school system helps national unity most?
(1) Denominational. (2) Denominational. (3) No opinion. (4) Secular. (5) Secular.

Comment _____( )

21. Do you think that school board members should be elected by residents of the school district or should they be appointed by the Quebec Board of Education?
(1) Elected. (2) Elected. (3) No opinion. (4) Appointed. (5) Appointed. (6) Both.

Comment _____( )

22. Some say that high schools should maintain high standards and those students who cannot successfully do the work should be dropped. Do you agree or disagree?
(1) Agree. (2) Agree. (3) No opinion. (4) Disagree. (5) Disagree.

Comment _____( )

23. (1) Male. (2) Female 23 ( )

24. Age (1) (2) (3) (4) 24 ( )

25. Social status (1) Highest. (2) Average. (3) Poor. 25 ( )

26. Languages (1) French. (2) English. (3) Bilingual. 26 ( )

27. Religion (1) Catholic. (2) Protestant (3) Jewish. (4) Other. (5) No. 27 ( )

28. Schooling (1) Elementary. (2) Some high school. (3) Finished high school. (4) Some College. 28 ( )
Age discontinued school_____.

29. Marital status (1) Single. (2) Married. (3) Widow. (4) Divorced. 29 ( )

30. No. of children in family. (1) (2) (3) (4) (5). 30 ( )

31. No. of brothers and sisters you have. (1) (2) (3) (4) (5). 31 ( )

CHARACTERISTIC LIMITATIONS OF THE INTERNAL TUNING OF SELECTED WIND INSTRUMENTS AS PLAYED BY AMATEURS

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I

Introduction

The purpose of the study here reported is to present data on the characteristic limitations of the internal tuning of selected wind instruments as played by amateurs. The investigations have been limited to the study of four instruments, namely, flutes, trumpets and cornets, and clarinets.

The internal tuning of wind instruments has reference to the accuracy of the scales, both diatonic and chromatic, which they produce. Several related problems in tuning were investigated to ascertain characteristic tendencies which have important implications in teaching and performance.

The flexibility ranges of the instruments are reported as conditioning factors in internal tuning. The human element, which is ever present, is variable and was investigated. Different room temperatures have disturbing effects on intonation, necessitating various tuning adjustments of instruments. These factors were also investigated. However, the chief investigations were concerned with the conditioning effects of different strength reeds and different lay mouthpieces on the tuning of a clarinet.

Since skilled musicians are proficient in forcing their instruments in tune, it was deemed of more practical importance to use amateurs for the investigations. The quantitative results thus obtained should give a clearer understanding of the problems encountered in the study and teaching of students of wind instruments.

II

Theoretical and Technical Considerations

Wind instruments present many perplexing problems to physicists. In general, they do not follow laws of open and closed pipes, of cylindrical and conical bores and of organ pipes whose frequencies can be predicted. This lack of uniformity of response is in part conditioned by the fact that many of the musical instruments are neither wholly conical nor cylindrical in construction. The lack of uniformity of the taper, the flare of the bell and, in some instances, the corrections for the fifth mode of vibration all contribute to the difficulty of establishing laws in wind instrument construction.

The FLUTE is an open pipe instrument which responds by blowing air across the blow hole near the end of the tube. The eddies of air (aeolian tones such as are found in the howling of the wind around a corner) called "edge tones" produce frequencies some of which are in accord with the air column in the flute. Thus the column of air is a resonator to reinforce, through its standing wave, this feeble edge tone.

In 1832 Theobald Boehm of Munich devised modern fingering for the flute. In 1847 he invented the cylindrical bore and metal tube with large covered finger holes. Boehm (23, p. 229) was the first man to make a musical instrument according to scientific principles, and his efforts have been rewarded by acclaim for having developed the most perfect woodwind instrument we have today.

The first octave of a flute sounds in the first mode of vibration with the node (point of least motion) located in the center of the vibrating

air column. The second octave responds with the second mode of vibration which contains two nodes and three antinodes. The third octave responds with several modes of vibration conditioned by the tones sounded and the fingering used.

Open pipes must have an antinode (point of most motion) at each end regardless of the mode of vibration. Theoretically the wave length of the fundamental tone is two times the length of the air column resonating; however, this is not actually true in practice. The antinode is found at some short distance out from the open end.

W. T. Bartholomew (2, p. 121) has this to say regarding the antinode which is found out from the end of an open pipe:

> For a cylindrical pipe, this distance is about three tenths of the diameter of the pipe. Thus, the actual wave-lengths produced by pipes are somewhat longer and the pitches somewhat lower than the pipe length itself would justify.

Mendenhall, Eve, Keys and Sutton (20, p. 213) in discussing the end correction for pipes state:

> For cylindrical open pipes of radius r, the correction to be added is 3.3r; for closed pipes the correction is 2.7r.

In the first and second octaves of the flute, higher pitches are produced by opening finger holes to shorten the air column. In the third register, cross fingering (segmentation) is required to make the dead end air chamber favorable to the end that is being used.

The problems of tone production in flute playing were studied by William F. Waldrop (38, p. 33). He used mechanical means for controlling the air stream which was directed across the blow hole. The results of his investigation are, in part, as follows:

> When the flute was blown with an apparatus which permitted the isolation and control of each of the factors used in playing, the following conclusions were reached: As many as 8 partials can be obtained from the fundamental by increasing the air pressure alone ——.
>
> The various factors used in playing were found to affect pitch and loudness as follows:
>
> A. Pitch and intensity both vary directly with air pressure.
>
> B. Pitch and intensity both vary inversely with the distance from the exit of the air stream to the edge of the blow hole.
>
> C. Pitch and intensity both vary inversely with the size of the exit.
>
> D. Pitch is affected only very slightly by the angle the air stream makes with the edge, when every other factor is held constant, at least through the degrees that are used in flute playing. However, the intensity varies as markedly ás with other factors and directly with the angle the air stream makes with the edge. The angle is the only factor which permits an increase in intensity without a change in pitch——.

The velocity of the air stream is actually the real variable which causes the changes in tone studied. Such other factors as distance (p. 54), size opening and pressure are simply means of varying the velocity of the air stream with the results shown.

CORNETS are open tubes and respond naturally to the "just" partial series. The principal conditioning factor of the internal tuning is the fifth mode of vibration[1] which is fourteen cents[2] flat when compared to the equally tempered scale. Some instrument builders make a correction for this fifth mode by placing a constriction in the tubing at a nodal point; however, this correction also raises the sixth mode of vibration[3], which becomes too sharp. Thus compromises are necessary to avoid much difficulty.

The tones resulting from the use of valves offer more problems. When the tones produced through the use of one valve are in tune, those made by a combination of valves are usually too sharp. The low "C#$_4$", which is produced by all three valves in combination, is about one-half semitone too high.

The CLARINET is a single reed instrument which when played responds chiefly as a closed pipe. The low register functions in the first mode of vibration, the second register responds with the third mode of vibration and the upper register primarily in the fifth mode of vibration.

[1] The fifth mode of vibration is the E_6, fourth space treble staff as played by a cornet.

[2] Cents — commonly used to designate hundredths of a semitone.

[3] The G_6, space above the staff.

Theoretically, the reed is forced to vibrate in the frequency which is common to the pipe when it functions in the first mode of vibration. To play the second register a speaker hole is opened which introduces an antinode in the air column of the pipe, conditioning it to overblow a twelfth. The third register is induced by segmentation (cross fingering in the dead end of the pipe) along with greater lip pressure on the reed.

In the conventional cylindrical closed pipe the third mode of vibration responds two hundredths of a semitone sharper (in reference to equal temperament) than the first mode; the fifth mode fourteen hundredths flatter than the first mode.

The speaker hole (octave or register key), a feature necessary to induce the higher modes of vibration in clarinets, oboes, saxophones, etc., is a detrimental conditioning agent for intonation. The induced antinode lies below the speaker hole when the pipe responds with its full length, and as consecutive holes are opened, the antinode advances up to and past the speaker hole. The tones formed with the antinode to either side of this speaker hole are raised slightly in pitch directly with the distance the antinode is away from the speaker hole.

The mode of vibration of a clarinet reed was a puzzling factor prior to the investigation by C. S. McGinnis and C. Gallagher (19, pp. 529-32). The results of this investigation are as follows:

1. During a large part of its cycle, the flow of air into the mouthpiece is completely cut off by the reed.
2. With the aperture closed, the reed appears motionless to the eye for about half the time of a complete cycle.
3. The fundamental frequency of the reed vibration as measured with the calibrated stroboscope is the same in all ranges to within one percent of the fundamental frequency of the tone produced.
4. For a tone of good quality the tip of the reed vibrates as a unit, e. g., it remains parallel to the facing of the mouthpiece. Tones of poor quality are associated with variations from the normal mode, and they may be encountered under a variety of playing conditions. If the blowing pressure is not brought up to the proper value, other small and very rapid vibrations are superimposed on the normal mode. These produce inharmonic partials which are undesirable. Still smaller blowing pressure may produce a "squeal". Here the tip of the reed no longer vibrates as a unit, but in parts along its width with a central nodal line parallel to its length. A poorly adjusted embouchure will cause this same sound at even higher blowing pressures. Good quality seems to be associated with symmetry both as regards embouchure, pressure and reed design.

The conventional theory is that the clarinet (25, p. 36) produces a pulse four times the length of its tube. Actual measurements have shown the fundamental pulse length to be 3.5 times instead of 4 times its tube length. This phenomenon, along with the fact that the reed is closed only one half of the time, indicates that the clarinet is a "hybrid". It is neither a closed pipe nor an open pipe but an unexplainable combination of the two. A closed pipe responds with a wave length 4 times its tube length. An open pipe responds with a wave length 2 times the length of the tube.

III

Review of Research

The EXPERIMENTAL literature bearing on the subject of internal tuning of wind instruments and related problems has given important findings which contribute to greater efficiency in teaching and guidance. The following studies selected for inclusion are of considerable merit.

Ralph Russel Pottle (22, p. 140) in an unpublished doctoral dissertation entitled "Intonation Problems in School Bands" reveals, in part, the following results and conclusions:

> The scale of the instrument is most nearly true when its key tone is tuned to the frequency used as the standard in the manufacture of the instrument. At that level, the necessary scaler compromises are at the minimum. Thus, it is quite obvious that dis-

regard for the pitch standard not only tends to disturb pitch relationships within the instrument resulting in faulty "internal tuning" but also causes an unstable shifting pitch level with its attendant problems.

An increase (p. 143) in temperature of the atmosphere on the stage from 70°F. to 85°F., which is not uncommon, results in a sharpening of 21 cents on the BBb sousaphones, of 13 cents on the French horns, and of 6 cents on the Bb clarinets. —— The influence of the player's breath (p. 144) upon the pitch level of the instrument is much more pronounced in lower temperature, and is less pronounced as room temperature approaches that of the breath.

Measures (p. 147) made during the experimental stage of this study reveal that frequency of tones on wind instruments is influenced by a variation in the loudness with which they are played. The frequency of tones on some wind instruments sharpen while those on others flatten by increasing the loudness from pianissimo to fortissimo. It was found that pitch of brass cup-mouthpiece instruments sharpen and single reed instruments flatten through this influence.

Comparison of the tuning tone (p. 149) and playing tone of sixty-six wind instrumentalists as measured by the stroboscope revealed a consistent tendency to play at a level slightly below that established in tuning.

Kenneth E. Stanton (32) in an unpublished master's thesis studied four quality levels of band instruments and compared them in tone and intonation. In this experiment all trumpets and clarinets, whose retail prices (Apr. 1, 1941) were eighty-two dollars or more, were considered first quality level instruments. Second quality instruments ranged from sixty to eighty-two dollars; third and fourth quality instruments ranged below sixty dollars. The results show that expert judges were in accord in placing the first and second quality level instruments in a high rating and the third and fourth quality instruments in a low rating. As a result of this study, Stanton recommended, for those who desire smaller investments for beginners, that "used" first or second quality level instruments, in good condition, be purchased.

Alvin W. Ahrens (1, p. 204) made an investigation concerning the effect of different depth mouthpieces on the tuning of a trumpet. He used a matched set of three mouthpieces, one having a shallow cup, one having a medium cup and the other a deep cup. The results were that the level of tuning of the trumpet was raised as the depth of the mouthpiece was reduced; the internal tuning was not appreciably affected by the different depth mouthpieces.

Discussion

In Pottle's study the change in temperature from 70°F. to 80°F. resulted in a sharpening of 6 cents on the Bb clarinets. It is reasonable to assume that wood clarinets would be affected differently than metal or composition clarinets. His statement that the scale of the instrument is most nearly true when its key tone is tuned to the frequency used as the standard in the manufacture of the instrument does not hold for all manufactures. The level of tuning as well as the internal tuning is improved on many clarinets in use today by an outward adjustment of the upper joint. In comparing the playing tone and the tone established in tuning, one must take into account the length and technique of warm-up used. Doctor Pottle's subjects warmed up their instruments by blowing successive breaths through the instruments for five minutes. This is a technique seldom employed in actual practice. From a practical standpoint the instruments were probably warmed up too much and consequently cooled off somewhat during the actual playing, causing the playing level to be slightly below that established in tuning.

Stanton points out in his investigation that high quality level instruments have better tone and intonation. It is important that beginners as well as advanced students have either new or used high quality instruments. The internal tuning of the low quality instruments was not as true as that of the high quality instruments.

In Ahrens' study the level of the tuning of a trumpet was raised as the depth of the mouthpiece was reduced. The shallow cup mouthpiece responded at a higher pitch level than the deep cup mouthpiece. The internal tuning pattern was not appreciably affected by the use of the different depth mouthpieces.

In general, the experimental evidence from studies on the internal tuning of wind instruments is quite meager. With a greater application of standard controlled techniques of research and the recently developed instruments for measurement and analysis of sound, this is predestined to become a more active field for research in the future.

IV

Objectives and Procedures

Objectives

More specifically the purposes of the investigations here reported are:

A. 1. To ascertain the characteristic internal tuning of flutes, cornets and clarinets as played by amateurs and
2. to determine the variability of a group of players after tuning to a standard.

B. To determine the tonal flexibility range of flutes, trumpets and clarinets as played by amateurs.

C. 1. To investigate the change of the internal tuning of a clarinet affected by adjusting the upper joint out 1/8 and 3/16 of an inch and
2. to determine the levels of tuning of a wood clarinet as affected by 60°, 70° and 80°F. room temperatures.

D. To ascertain the effect, if any, of three different lay mouthpieces using three different strength reeds on the tuning of a clarinet.

Plans of the Investigations

In this research, fifteen different investigations were conducted. High school and college instrumentalists assisted at various times to make the tests. Each subject used his own instrument, the instruments being of various makes, except for the final investigation in which a new wood clarinet was used.

A Stroboconn was used for measuring the frequencies of the various tones. This instrument is based on a synchronous motor, supplied by a fork unit with 55 cycle power and intermittent light, the frequency of which is controlled by pulsations of sound reaching a microphone. Twelve rotating disks, representing the equally tempered semitones in an octave, are each imprinted with a pattern of seven rings of alternate light and dark segments progressing radially for a range of seven octaves. Intermittent light superimposed upon disks revolving at a constant rate forms an image, which, adjusted to a position of no apparent movement, indicates a frequency reading on the dial. The error of this reading is less than five hundredths of one percent.

Mean room temperatures of 74°F. (±2) prevailed which were taken to be normal variations in rehearsal room temperatures. The warm-up in each of these investigations consisted of playing a diatonic scale, up, down, up, down, for the entire range of the instrument The tones were taken at a moderate tempo.

A. In order to ascertain the characteristic internal tuning of flutes, cornets and clarinets, a set procedure was used.

Nine flutists were obtained to make a series of tests. Each warmed up his instrument, after which he tuned his second octave "C" to a "C" (523.25 cycles) on the Stroboconn based on a four forty (440) standard for A. He slowly played the C major scale starting on middle "C" for a distance of three octaves up, down, up, down, up, down for a total of six trials. The frequency of each note was measured and an average taken of the six trials. The mean performance of each S was charted on an individual graph. This same procedure was followed by the ten instrumentalists who served as subjects for the cornet tests and by the twenty musicians who served as subjects for the clarinet tests. The tuning tone used for the cornets and clarinets was the concert Bb (466.16 cycles).

B. To determine the tonal flexibility range of the various instruments, the subject warmed up his instrument and tuned to an A (440) standard, as previously explained. The subject was instructed how to sharp and flat a given tone. This was to be done without appreciably changing the tone in loudness and quality. Five practice tones were played to acquaint the subject with the procedure. At each pitch the normal tone was played first, which was used as the standard for loudness and quality. The subject then played the tone flat according to the restricted requirements. This tone was measured. Then the tone was played sharp, and measured. The distance between these two inflected tones was declared to be the flexibility range for this tone, by this subject on his particular instrument. The readings for a diatonic scale were thus acquired and plotted on a graph for each subject.

C. To investigate the change in internal tuning induced by the outward adjustment of the clarinet upper joint, a subject was selected who had a firm embouchure. After warming up, a series of tests were made with the joint up tight, followed by a series of tests for each of the following positions: the upper joint pulled out 1/8 of an inch and 3/16 of an inch. A constant room temperature was maintained throughout the experiment. The results were plotted on a graph.

D. The results of the A. and B. investigations (see Fig. 6.) brought forth the question: Are there any other contributing factors, other than the length of the vibrating air column and the placement of the tone holes, which condition the internal tuning of a clarinet? Several uncontrolled tests made by the experimenter, in which different strength reeds and different lay mouthpieces were used on the same instrument played by the same subject, revealed a marked consistency for the close lay mouthpieces and the stiff reeds to play sharper than the open lay mouthpieces and the weak reeds, especially in the low register. Thus it came about that the objective of ascertaining the effect, if any, of three different lay mouthpieces using three different strength reeds on the tuning of a clarinet was put to a controlled test.

The materials and apparatus used to ascertain the effect, if any, of three different lay mouthpieces using three different strength reeds on the tuning of a clarinet were as follows: Stroboconn; new clarinet; matched set of three different lay crystal mouthpieces; matched set of three different strength reeds; thermometer; chart listing five critical tones[1]; charts of the randomized design for testing; especially designed data sheet; table and chairs.

An explanation of the derivation of the five critical tones is as follows: The "F_3" has little flexibility and it is the flattest tone (see Figs. 6. and 7.) in the lower register; the "A_4" is a "throat" tone which is usually played too sharp and is extremely flexible; the "B_4" is the flattest tone in the second register and the least flexible; the "C_5" is the sharpest tone in the second register accompanied by moderate flexibility; the "G_5" is a difficult tone for amateurs to produce, it is difficult to play in tune and the tone is quite variable.

In collecting the data, the subject sat opposite the experimenter who made the readings and recorded the data. An assistant handed the subject the three different strength reeds[1], the three different lay mouthpieces[2] and the new clarinet. The subject warmed up the clarinet, using the reeds and mouthpieces. The room temperature was checked and held constant. The subject was instructed in the procedure to be followed. This was to tongue the note four times (ta, ta, ta, taaaaaaa) holding the last tone, which was to be measured. The subject practiced the five critical tones to be investigated, using the new clarinet with the experimental mouthpieces and reeds.

ORDER OF PRESENTATION OF REED-MOUTHPIECE COMBINATIONS FOR TESTING

A	B	C	D	E	F	G	H	I
I	A	B	C	D	E	F	G	H
H	I	A	B	C	D	E	F	G
G	H	I	A	B	C	D	E	F
F	G	H	I	A	B	C	D	E
E	F	G	H	I	A	B	C	D
D	E	F	G	H	I	A	B	C
C	D	E	F	G	H	I	A	B
B	C	D	E	F	G	H	I	A
A	B	C	D	E	F	G	H	I

Reed-Mouthpiece Combinations:

A	B	C	D	E	F	G	H	I
Op.	Me.	Cl.	Cl.	Op.	Me.	Me.	Cl.	Op.
2	2½	3	2½	3	2	3	2	2½

(Op—Open lay mouthpiece; Me—Medium lay mouthpiece; Cl—Close lay mouthpiece)
(2—Weak reed; 2½—Medium reed; 3—Strong reed)

Fig. 1. Showing the modified LATIN SQUARE design of the experiment with the COUNTERBALANCED order of Reed-Mouthpiece combinations.

When all was in readiness the assistant selected the first reed-mouthpiece combination (see Fig. 1.), which was the open lay mouthpiece and the weak No. 2 reed. (The subject at no time knew what combination

[1] The five critical tones are: "F_3" on the clarinet, (155.56 cycles); "A_4", (392 cycles); "B_4", (440 cycles); "C_5", (932.33 cycles); and "G_5", (1396.9 cycles).

[1] The types of reeds tested were: a weak No. 2 reed, a medium No. 2½ reed and a strong No. 3 reed.

[2] The types of mouthpieces tested were: an open lay, a medium lay and a close lay mouthpiece.

was being tested or what the readings were.) The subject played "F_5", the first of the five critical tones, tonguing it four times. The last tone was measured and recorded. In like manner he played the other critical tones which were measured. The assistant then gave him the second combination which consisted of a medium lay mouthpiece and a medium No. 2½ reed, following the preconceived design of the experiment. The same playing-measuring procedure was followed again for each of the five critical tones. In like manner, the nine different combinations of reeds and mouthpieces were tested for each of the five critical tones for a total of four hundred and fifty readings.

Increments in Measuring

In order to gain a better understanding of the increments used in measuring and plotting of the graphs, it is well to know that at A (440) a deviation of four hundredths of a semitone is equal to about one cycle per second. Thus it is possible to plot variations that are below the threshold of discrimination by the ear (J. N. D.). The increments, given in Table I, show some of the relationships.

Table I

Frequencies Per Second For An Equally Tempered Chromatic Scale With 10 Cents Plus And Minus Deviations (Adapted from Young)

Scale tones	C	C#	D	D#	E	F
+ 10 cents deviation	263.14	278.79	295.37	312.93	331.54	351.25
EQUALLY TEMPERED	261.63	277.18	293.66	311.13	329.63	349.24
— 10 cents deviation	260.12	275.59	291.97	309.34	327.73	347.22

Scale tones	F#	G	G#	A	A#	B
+ 10 cents deviation	327.14	394.27	417.71	442.55	468,86	496.74
EQUALLY TEMPERED	369.99	392.00	415.30	440.00	466.16	493.88
— 10 cents deviation	367.86	389.74	412.91	437.47	463.48	491.04

V

Results and Implications

Internal Tuning of a Flute

The internal tuning pattern follows quite closely the known facts concerning the more or less flat lower register (Fig. 2.) and the sharp third register. Two phenomena which are evidenced are the flat "E_5" in the second register and the sharp "F_6" in the third register accompanied by a recession of "G_6" and "A_6", the two following tones. The inaccurate tuning of this third register causes much intonation difficulty for amateurs.

Comparison of Levels of Tuning and Playing Tones

Comparison of the tuning and playing tones (the "C_5") shows the playing tone to be 4 cents higher (Fig. 2.) than the tuning tone "C_5" based on an A (440) standard. This is not wholly in accord with Dr. Pottle's (22, p. 149) findings.

Flexibility Range of a Flute

The investigation (Fig. 3.) shows a very wide range of flexibility throughout the first

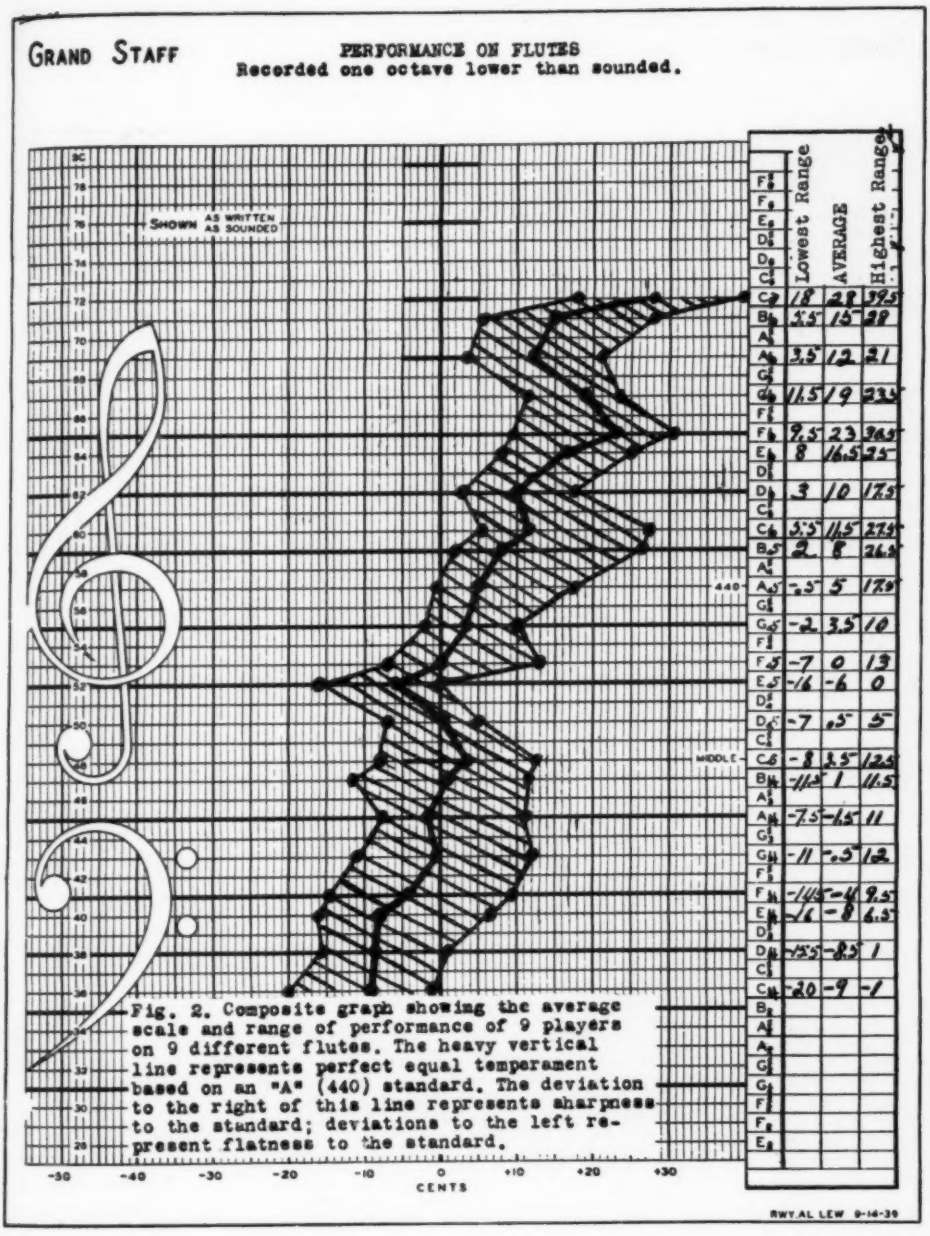


Fig. 2. Composite graph showing the average scale and range of performance of 9 players on 9 different flutes. The heavy vertical line represents perfect equal temperament based on an "A" (440) standard. The deviation to the right of this line represents sharpness to the standard; deviations to the left represent flatness to the standard.

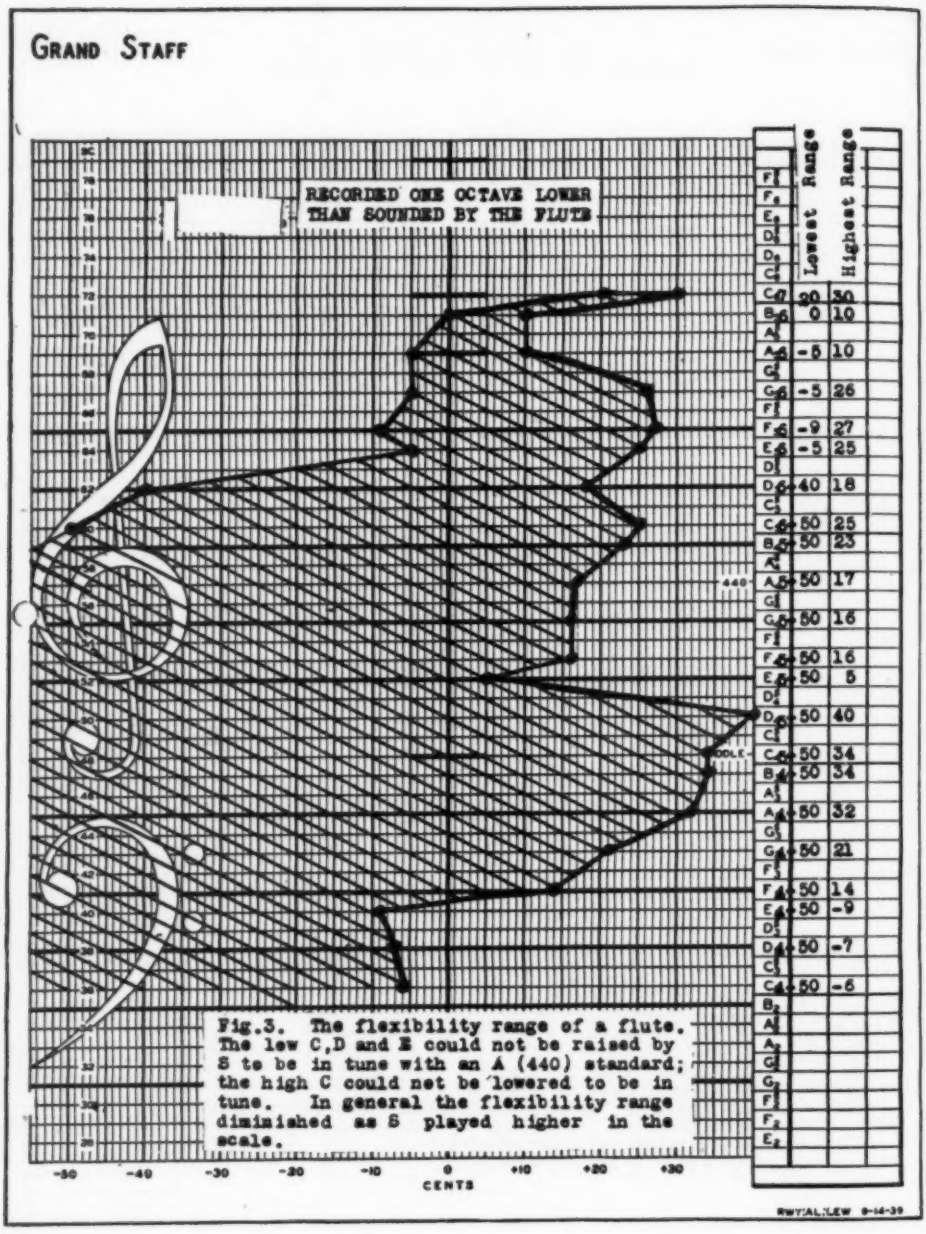
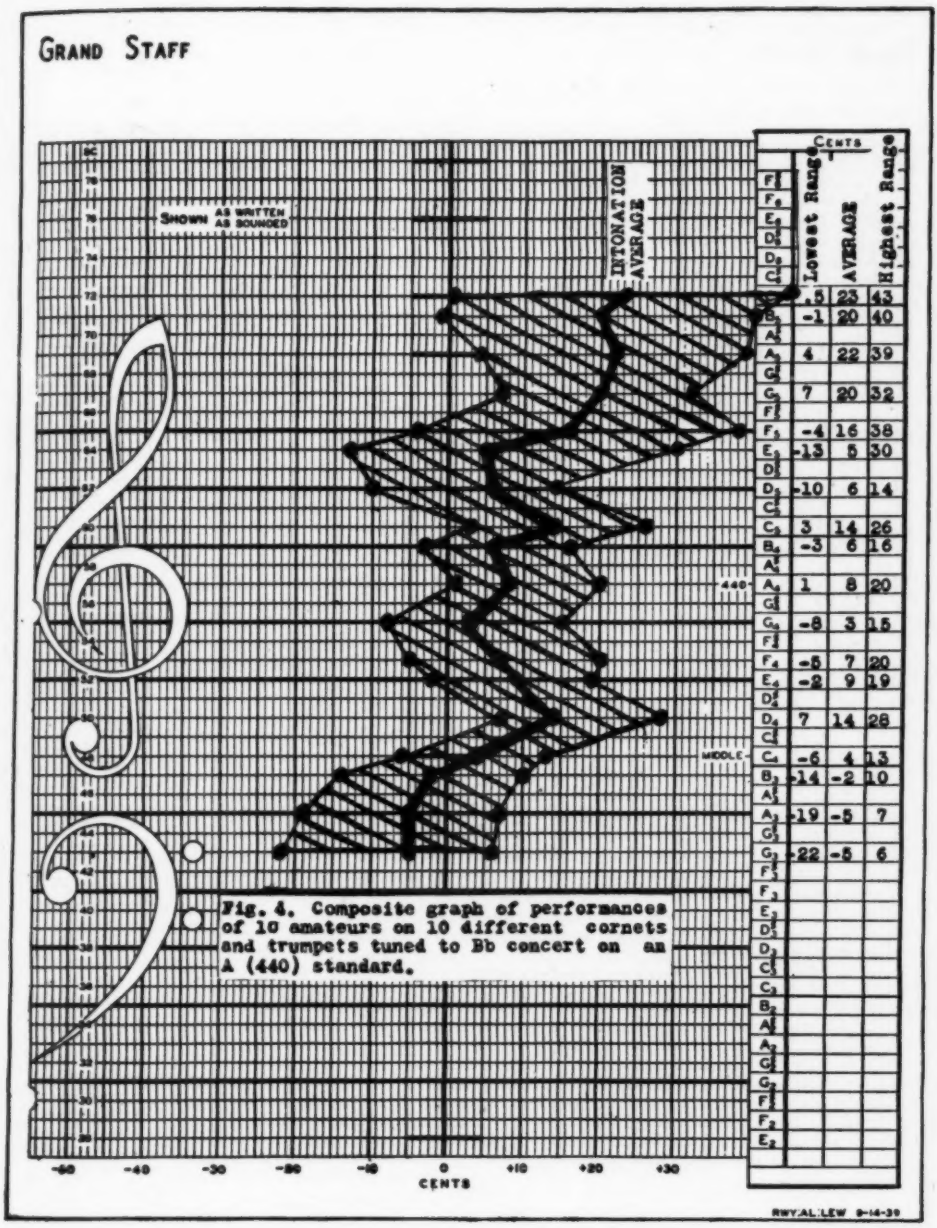


Fig.3. The flexibility range of a flute. The low C, D and E could not be raised by S to be in tune with an A (440) standard; the high C could not be lowered to be in tune. In general the flexibility range diminished as S played higher in the scale.



	Lowest Range	AVERAGE	Highest Range
C_5	-5	23	43
B_4	-1	20	40
A_4	4	22	39
G_4	7	20	32
F_4	-4	16	38
E_4	-13	5	30
D_4	-10	6	14
C_4	3	14	26
B_3	-3	6	16
A_3	1	8	20
G_3	-8	3	15
F_3	-5	7	20
E_3	-2	9	19
D_3	7	14	28
C_3	-6	4	13
B_2	-14	-2	10
A_2	-19	-5	7
G_2	-22	-5	6

Fig. 4. Composite graph of performances of 10 amateurs on 10 different cornets and trumpets tuned to Bb concert on an A (440) standard.

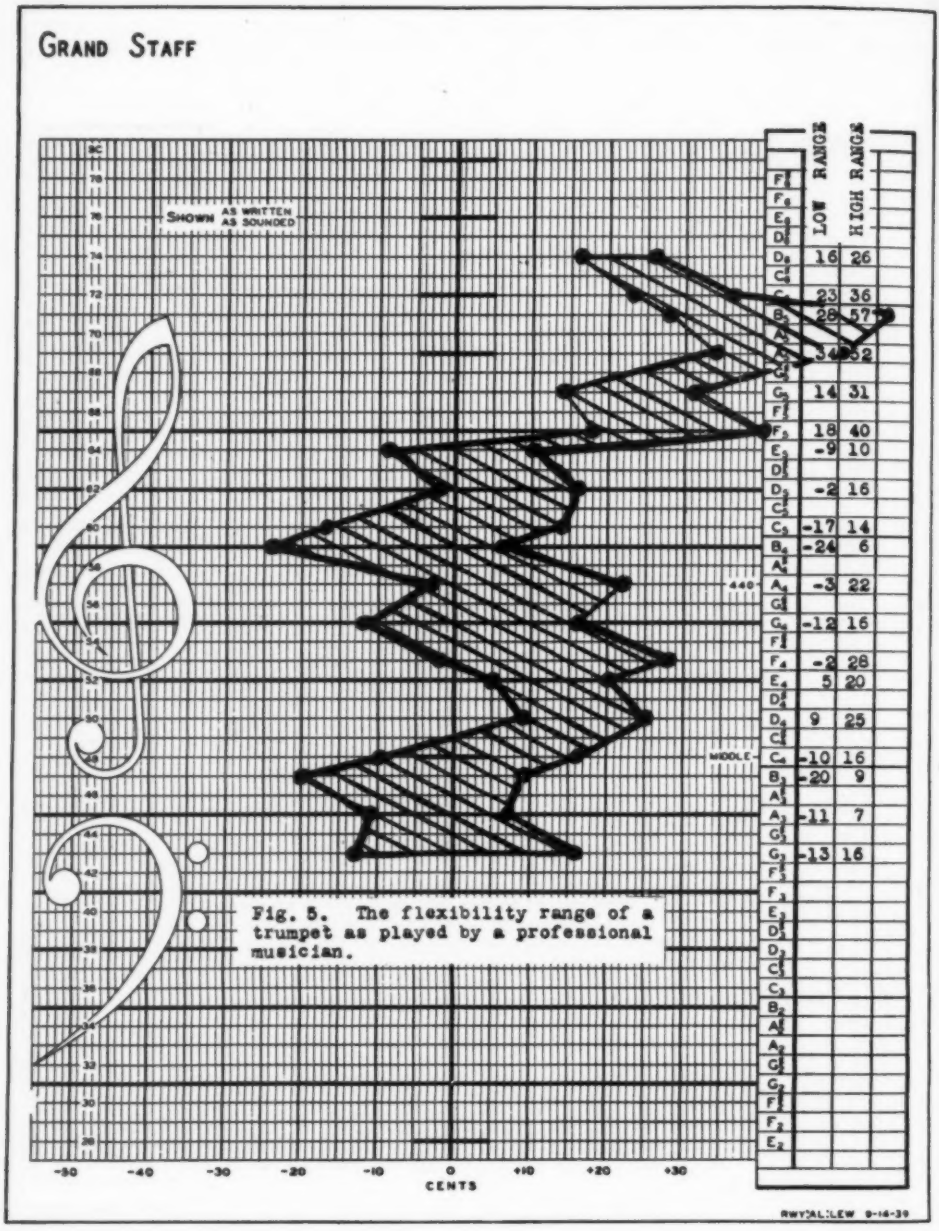


Fig. 5. The flexibility range of a trumpet as played by a professional musician.

two octaves of a flute. In this range the easiest deviation is made on the flat side of standard tuning. The first three tones "C_4", "D_4" and "E_4" could not be raised to the standard necessary to be in tune. The second octave "E_5" could be raised only 5 cents above the standard, which is indeed a very small amount. In the third octave the flexibility narrows down to a very small range with the high "C_7" remaining as an unmanageable tone to play in tune. These high tones are difficult for amateurs to produce, and when they are played the pitch is conditioned primarily by the instrument.

Internal Tuning of Cornets and Trumpets

The three lowest tones (Fig. 4.) "G_3", "A_3" and "B_3" are generally played below standard tuning even though two of the tones are formed by using valves in combination. The "D_4" is quite sharp; not one subject played it down to standard. The general trend of the tuning is sharper the higher a tone ascends in the scale with the exceptions "G_4" and "E_5" where there are recessions in pitch. The "E_5" (fifth mode of vibration), which is 14 cents flat on an uncorrected instrument, shows an unusual spread indicating that some instruments lacked any correction and others were corrected too much. The usual sharpness of "F_5", "G_5", "A_5", "B_5" and "C_6" is quite evident; many professionals as well as amateurs fail to lower these tones to be in tune.

Comparison of Levels of Tuning and Playing Tones

The tuning tone used was the "C_5" on the cornets and trumpets ("Bb_4" concert pitch). The mean playing level (Fig. 4.) was 14 cents higher than the standard of tuning. Every performer played at a higher level than he tuned. These findings are not in accord with those of Dr. Pottle (22, p. 149).

Flexibility Range of a Trumpet

The criteria established in gaining the flexibility range were: equal loudness and same quality of the normal tone, and the high and low range tones. Thus the flexibilities of various instruments are conditioned by the high standard of tone quality the performer can produce. The professional player (Fig. 5.) had a very narrow range of flexibility. His high standard of tone quality and keen sense of equal loudness kept this range to a minimum. It is interesting to note the very narrow range of the highest notes on the trumpet. It was impossible for this subject to play these tones down to the standard even without satisfying the criteria laid down.

Internal Tuning of Clarinets

The internal tuning pattern of clarinets (Fig. 6.) shows the "A_3" and the "B_3" as the two sharpest tones in the low register. It is generally known that "throat tones" are sharp, and therefore unusual consideration is given these tones to play them lower, with the result that the lower tones are not suspected. The "B_4" is the flattest tone on a clarinet. The general intonation rises to "C_6", from which point it again recedes.

Flexibility Range of a Clarinet

The investigation (Fig. 7.) shows a very narrow flexibility range for the tones "E_3", "F_3", "B_4", "C_5", "D_5", "E_5", "F_5", and "G_5". The "throat tones" of the lower register have considerable flexibility especially in the sharp direction. In the third register the flexibility increases over what it was in the second register. The highest tones in the third register are difficult for amateurs to produce, and when they are sounded the pitch is conditioned primarily by the player.

Effects of Adjusting the Upper Joint

The study (Fig. 8.) shows that the performer had an improper embouchure for playing the low register. All except three tones were played too sharp. The results of the outward adjustments clearly show that any adjustment of the upper joint affects the throat tones ("E_4", "F_4", "G_4", "A_4") and the third register tones ("E_6", "F_6", "G_6") much more than the others in the scale. The "G_6" was lowered 37 cents while the "G_5" and "A_5" were lowered only 18 cents by the outward adjustment of 3/16 inch. The "G_4" was affected most with a change of 63 cents.

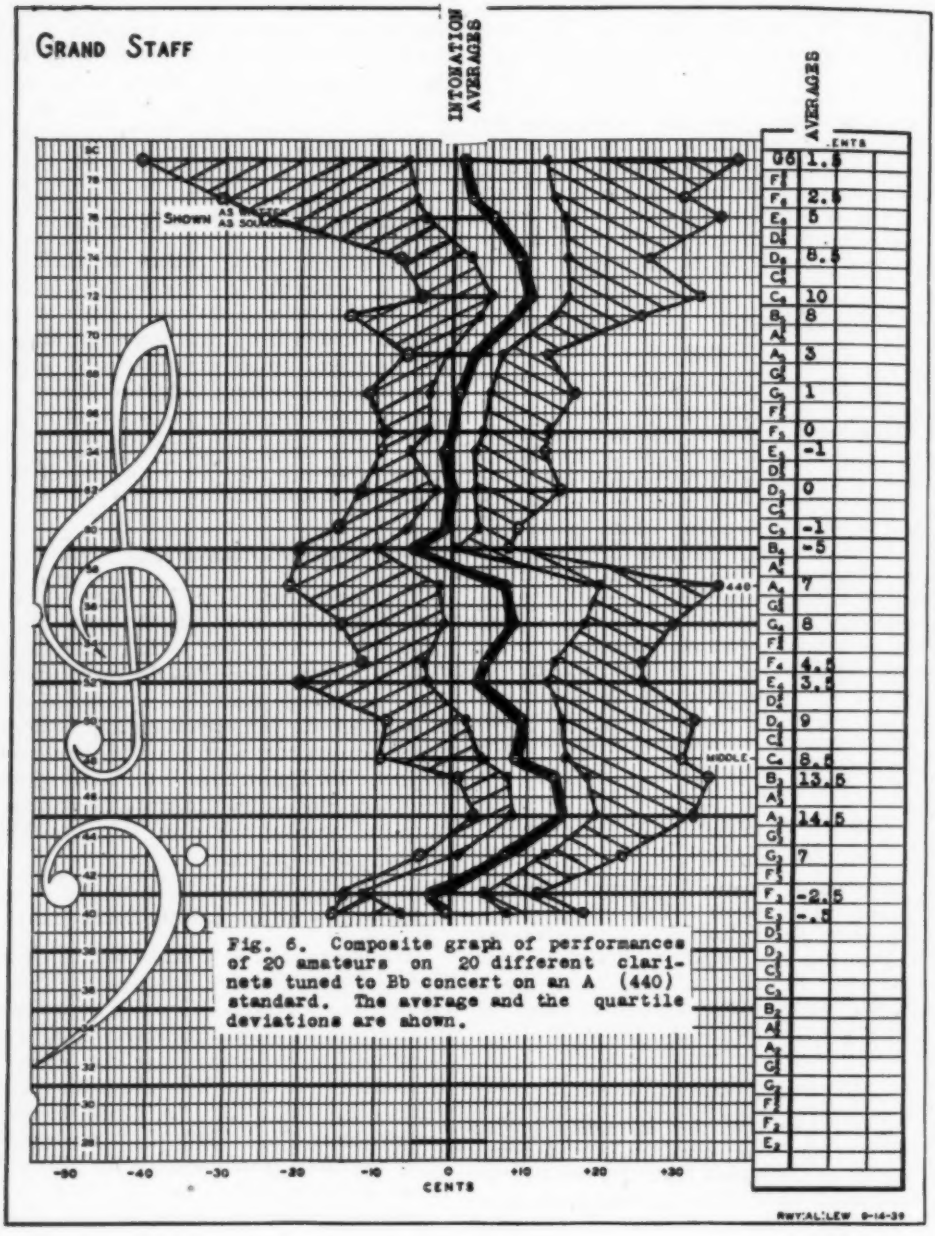


Fig. 6. Composite graph of performances of 20 amateurs on 20 different clarinets tuned to Bb concert on an A (440) standard. The average and the quartile deviations are shown.

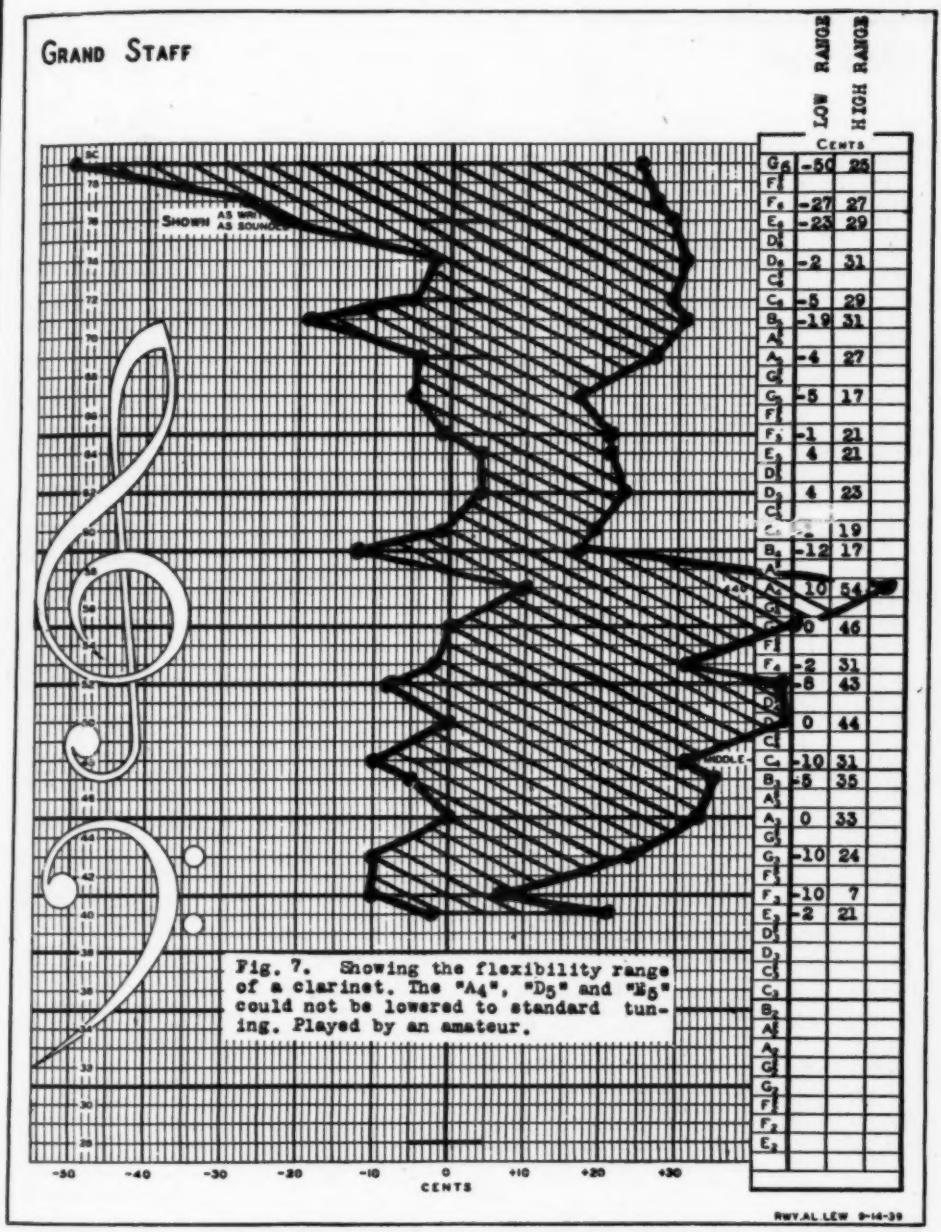


Fig. 7. Showing the flexibility range of a clarinet. The "A_4", "D_5" and "E_5" could not be lowered to standard tuning. Played by an amateur.

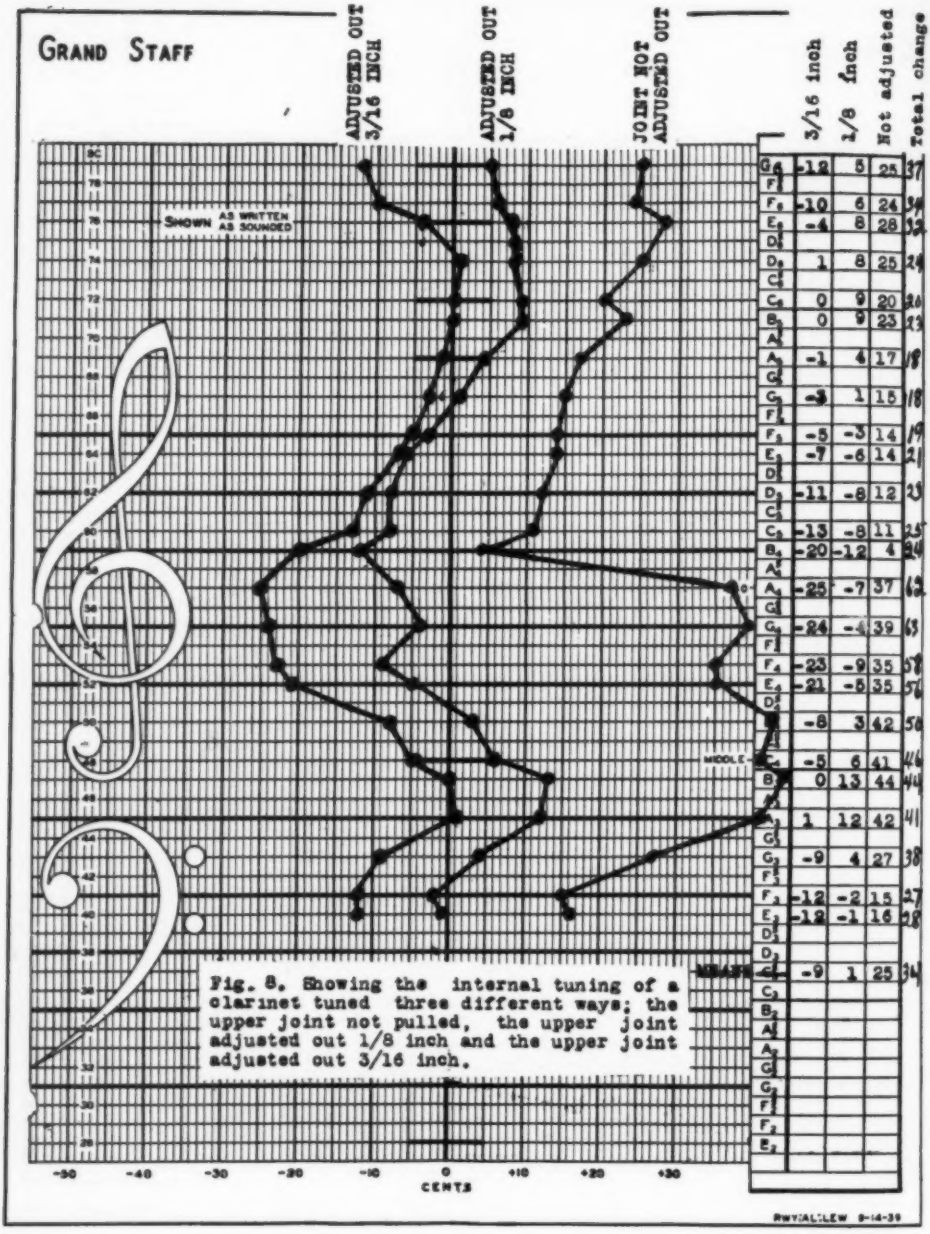


Fig. 8. Showing the internal tuning of a clarinet tuned three different ways; the upper joint not pulled, the upper joint adjusted out 1/8 inch and the upper joint adjusted out 3/16 inch.

Effects of 60°F., 70°F. and 80°F. Room Temperatures on the Level of Tuning of a Wood Clarinet

The results of 288 readings[1] taken at each of the room temperatures 60°F., 70°F. and 80°F. were as follows: at the 60°F. room temperature the level of tuning was 7 cents above the A (440) standard; at the 70°F. room temperature the level of tuning was 18 cents above and at the 80°F. room temperature it was 36 cents above standard tuning. In relating frequency to cents: the 7 cents deviation has a frequency reading of 441.78 cycles; the 18 cents deviation has a frequency reading of 444.6 cycles and the 36 cents deviation has a frequency reading of 449.25 cycles. (These are all deviations from the A (440) standard at "A_4".) There is a sharpening of 11 cents effected by changing the temperature from 60°F. to 70°F.; while the effects of changing the room temperature from 70°F. to 80°F. resulted in a change of 18 cents in the level of tuning. The related frequency changes are: the change from 60°F. to 70°F. resulted in a frequency change of 2.62 cycles; the change from 70°F. to 80°F. resulted in a frequency change of 4.65 cycles.

[1] Twelve readings were taken for each of 24 diatonic tones on the clarinet at each of the three temperatures for a total of 864 readings. The experimenter served as the subject with an assistant making the readings. A new wood clarinet, with three different reed-mouthpiece combinations, was used. Each combination was used for 1/3 of the readings at each temperature level. The combinations used were: weak No. 2 reed with an open lay mouthpiece; medium No. 2-1/2 reed with a medium lay mouthpiece and a strong No. 3 reed with a close lay mouthpiece. At each temperature level the readings were averaged.

The Effects of Three Different Lay Mouthpieces Using Three Different Strength Reeds on the Tuning of a Clarinet

The results of tests made using the medium lay mouthpiece and the medium No. 2½ reed were invalidated. The subject reported that the reed did not respond as freely as the other two used and it was observable to the experimenter that the tones produced had "stuffy" quality. The medium mouthpiece did not respond as freely as the other two mouthpieces with any of the reed combinations and was declared to be defective equipment. Thus there remained the data from two different mouthpieces and two different reeds for treatment. (Table II.)

Table II

Frequency Readings with Means and Standard Deviations for Four Different Reed-Mouthpiece Combinations

Reed Mouthpiece Combinations		Critical Tones	Data of Tests										M	S.D.
Open	Lay	G_5	33	40	34	43	34	39	47	34	36	37	37.7	4.372
		C_5	36	38	40	27	40	41	30	27	34	33	34.6	5.296
Weak	Reed	B_4	19	16	17	12	14	21	16	16	18	17	16.6	2.5
		A_4	50	47	46	46	48	48	44	45	42	44	46.	2.357
		F_4	20	22	22	22	19	21	18	19	22	19	20.4	1.578
Close	Lay	G_5	39	29	30	19	35	41	34	31	32	33	32.3	6.019
		C_5	40	32	35	36	39	26	33	34	33	35	34.3	3.889
Strong	Reed	B_4	26	24	24	21	23	20	17	21	24	25	22.5	2.718
		A_4	59	61	59	60	57	61	56	56	57	57	58.3	1.946
		F_4	28	29	31	31	30	30	30	32	29	28	29.8	1.32
Open	Lay	G_5	30	29	32	20	39	28	33	29	29	26	29.5	4.882
		C_5	42	38	24	26	39	26	24	30	34	33	31.6	6.603
Strong	Reed	B_4	22	22	17	12	14	16	18	16	22	20	17.9	3.542
		A_4	58	54	51	53	58	62	56	58	55	56	56.1	3.107
		F_4	26	25	23	24	25	26	24	26	26	24	24.9	1.1
Close	Lay	G_5	39	50	51	45	43	43	44	45	41	41	42.2	3.824
		C_5	40	35	41	39	42	40	35	35	33	32	37.2	3.584
Weak	Reed	B_4	20	19	20	21	19	24	25	21	22	22	21.3	2.
		A_4	44	48	45	51	51	46	49	48	48	48	47.8	2.3
		F_4	22	28	27	24	24	26	27	24	25	26	25.3	1.828

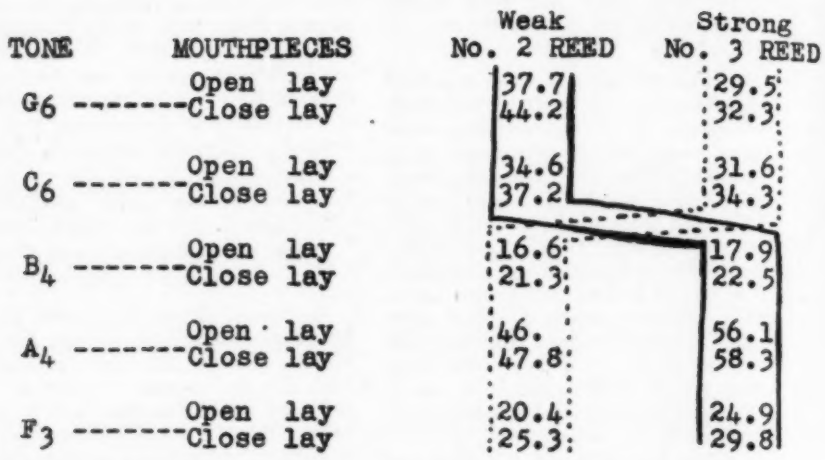


Fig. 9. Showing the PITCH REVERSAL of two different strength reeds. The strong reed is sharper than the weak reed for the three lower tones and flatter than the weak reed for the two highest tones.

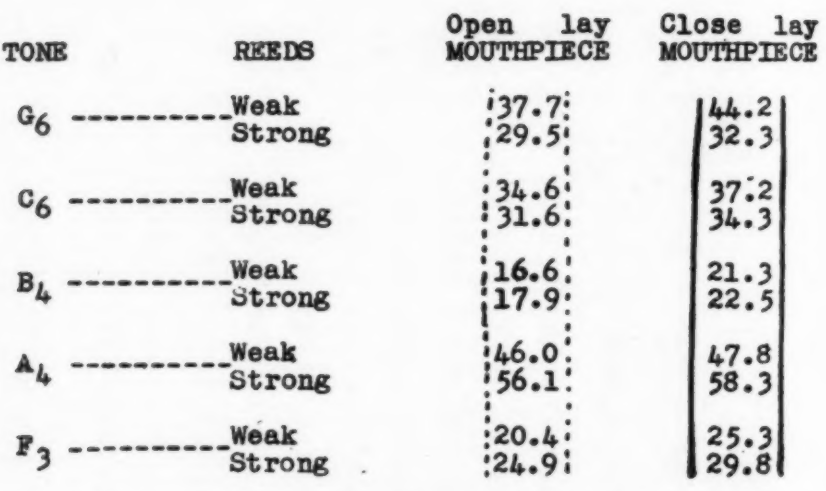


Fig. 10. Showing the PITCH CONDITIONING factors of two different lay mouthpieces. The close lay mouthpiece responded sharper for all tones tested than the open lay mouthpiece.

The results of the frequency readings show that the strong reed responded with a higher pitch than the weak reed for the tones "F_3", "A_4" and "B_4". At this point an absolute reversal appeared. For the tones "C_6" and "G_6" the strong reed responded lower in pitch than the weak reed. It will be observed in Fig. 9. that the reeds reversed consistently when used on either the close lay or the open lay monthpieces.

This strange reversal phenomenon may be explained if it is found in subsequent research that the strong reed has its own natural frequency near "G_5". In that event the low tones possibly are raised through the strength of the strong reed, and the high tones are lowered by the same function. The weak reed, through its efficiency, probably responds more truly sympathetically with the frequencies of the resonating column of air in the tube.

The data show that the type of mouthpiece used conditioned the level of tuning of a clarinet. Regardless of the strength of reed used, the close lay mouthpiece played at a higher pitch than the open lay mouthpiece. This phenomenon is consistent throughout the entire range of the clarinet, as evidenced in Fig. 10.

This phenomenon may be explained by the fact that the reed lies closer to the close lay mouthpiece than to the open lay mouthpiece. Thus a smaller part of the reed is left free to vibrate. It is the shorter functioning part of the reed, with a higher natural frequency which conditions the pitch to be higher.

In the following statistical studies the significance of these phenomena is ascertained. The studies show the significant differences between the two types of mouthpieces and reeds used in producing the five critical tones.

TABLE III shows the critical ratios for the two types of mouthpieces used for sounding the critical tones and TABLE IV shows the critical ratios for the two types of reeds used. An analysis of variance (TABLE V) concludes the study.

TABLE III

CRITICAL RATIOS OF TWO DIFFERENT LAY MOUTHPIECES SOUNDING THE FIVE CRITICAL TONES

TONE	MOUTHPIECES	REED	DIFF.	σD	"t"[1]
G_5	Open lay Close lay	No. 2	6.5	1.99	3.27
	Open lay Close lay	No. 3	2.8	2.58	1.08
C_6	Open lay Close lay	No. 2	2.6	2.13	1.22
	Open lay Close lay	No. 3	2.7	2.55	1.06
B_5	Open lay Close lay	No. 2	4.7	1.07	4.4
	Open lay Close lay	No. 3	4.6	1.49	3.09
A_4	Open lay Close lay	No. 2	1.8	1.1	1.64
	Open lay Close lay	No. 3	2.2	1.22	1.8
F_3	Open lay Close lay	No. 2	4.9	.81	6.09
	Open lay Close lay	No. 3	4.9	.57	8.55

[1] In this table "t", with 18 degrees of freedom, must be greater than 2.10 to be significant at the 5% level and 2.88 at the 1% level.

TABLE IV

CRITICAL RATIOS OF TWO DIFFERENT STRENGTH REEDS SOUNDING THE FIVE CRITICAL TONES

TONE	REEDS	MOUTHPIECE	DIFF.	σD	"t"[1]
G_3	No. 2 No. 3	Open lay	8.2	2.23	3.68
	No. 2 No. 3	Close lay	11.9	2.38	5.01
C_4	No. 2 No. 3	Open lay	3.	2.82	1.06
	No. 2 No. 3	Close lay	2.9	1.76	1.65
B_4	No. 2 No. 3	Open lay	1.3	1.45	.9
	No. 2 No. 3	Close lay	1.2	1.13	1.07
A_4	No. 2 No. 3	Open lay	10.1	1.3	7.77
	No. 2 No. 3	Close lay	10.5	1.01	10.45
F_3	No. 2 No. 3	Open lay	4.5	.66	6.85
	No. 2 No. 3	Close lay	4.5	.75	5.99

[1] In this table "t", with 18 degrees of freedom, must be greater than 2.10 to be significant at the 5% level and 2.88 at the 1% level.

The data in Table III seem to show that, for the tone "F_3", the lay of the mouthpiece is an important conditioning factor. The high level of confidence scores of 6.09 and 8.55 indicate a real difference in the two types of mouthpieces used for this tone. There is also a significant difference revealed for the tone "B_4" and a significant difference for the "G_6" when a weak reed is used. For the other tones "A_4", "C_6" and "G_6", ("G_6" when a strong reed is used) the differences are not significant.

The importance of the type of reed used is forcefully shown in Table IV. The very high level of confidence scores revealed for the tones "F_3", "A_4" and G_6" indicate there is a real difference in the reeds. For the tones "F_3", "A_4" and "B_4" the strong reed raises the pitch, and for the tones "C_6" and "G_6" it lowers the pitch.

The *Analysis of Variance* (31, p. 276) (Table V) results show no significant interaction between the mouthpieces and reeds producing the five critical tones. The type of mouthpiece used is important for the tones "F_3", "A_4", "B_4" and "G_6". For these tones the difference between the open lay and the close lay mouthpieces is a significant factor. For the tones that have little flexibility (see Fig. 7.) the pitch produced by the close lay mouthpiece is higher than that produced by the open lay mouthpiece to an extent that is highly significant.

The type of reed used is of considerable importance for the tones "F_3" and "G_6". For the tone "F_3" the strong reed raised the pitch significantly and for the tone "G_6" the strong reed lowered the pitch significantly. For the tone "A_4" the type of reed used is of extraordinary importance. This "throat tone" is usually too high in pitch and causes much intonation difficulty. The strong reed raised the pitch of this tone over what it was when played with a weak reed to a degree that is highly significant.

TABLE V

RESULTS OF ANALYSIS OF VARIANCE BETWEEN MOUTHPIECE APPLICATIONS AND BETWEEN REED APPLICATIONS FOR THE FIVE CRITICAL TONES

Sources of Variation	D.F.	Sum of Sqs.	Mean Sq.	F Ratio
TONE "G_4"				
Mouthpiece application	1	216.225	216.225	9.05***
Reed application	1	1010.025	1010.025	42.27*****
Interaction	1	34.225	34.225	1.43
Replication	36	860.3	23.897	
Totals	39	2120.775		
TONE "C_5"				
Mouthpiece application	1	70.225	70.225	2.82
Reed application	1	87.025	87.025	3.49
Interaction	1	.025	.025	.001
Replication	36	896.5	24.903	
Totals	39	1053.775		
TONE "B_4"				
Mouthpiece application	1	216.225	216.225	28.63*****
Reed application	1	15.625	15.625	2.07
Interaction	1	.025	.025	.003
Replication	36	271.9	7.553	
Totals	39	503.775		
TONE "A_4"				
Mouthpiece application	1	40.	40.	6.59**
Reed application	1	1060.9	1060.9	174.72*****
Interaction	1	.4	.4	.066
Replication	36	218.6	6.072	
Totals	39	1319.9		
TONE "F_5"				
Mouthpiece application	1	240.1	240.1	109.43*****
Reed application	1	202.5	202.5	92.3*****
Interaction	1	0.	0.	0.
Replication	36	79.	2.194	
Totals	39	521.6		

In this table n_1 equals 1 degree of freedom and n_2 equals 36 degrees of freedom. However, to use the higher significance[1] tables, n_2 has been taken to equal 30 degrees of freedom.

In this table "F" must equal the following amounts with the significant % levels indicated.

* 4.18 = 5. % level
** 5.57 = 2.5% level
*** 7.56 = 1. % level
**** 9.18 = .5% level
*****13.29 = .1% level

[1] The 1% and .1% levels were taken from the statistical tables of R. A. Fisher and F. Yates. The other levels were taken from the tables of M. Merrington and C. M. Thompson.

Fig. 11. shows the relative VARIANCE of the mouthpieces and reeds. The type of reed used seems to be of greater importance than the type of mouthpiece used. However, it must be noted that the mouthpiece variance is a conditioning feature for those tones having little flexibility, therefore the type of mouthpiece used is of great consequence, at least, for some intonation problems.

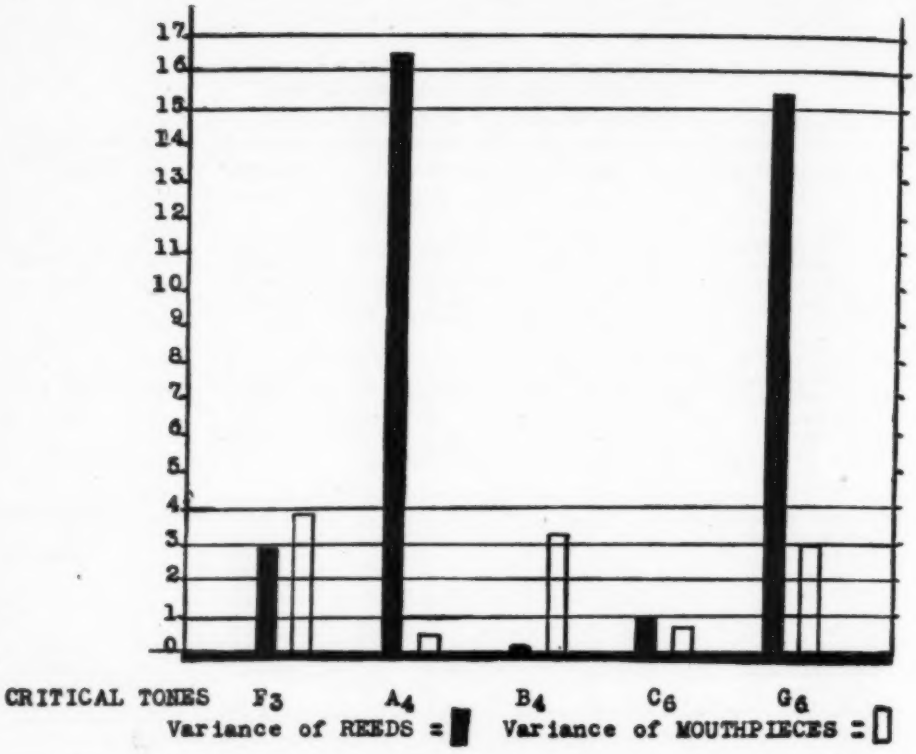


Fig. 11. Showing the variance of the reeds and the variance of the mouthpieces for the five critical tones.

VI

Conclusions and Recommendations

The results of the foregoing investigations indicate a general tendency for wind instruments to play sharper as they ascend into the upper ranges. Performers on the clarinets and trumpets seem to be more variable than those performing on the flutes. This more uniform performance by the flutists is probably due to a more accurate internal tuning of the instrument.

Specific conclusions and recommendations for the various instruments investigated are as follows:

The flute is a very flexible instrument for the first two octaves. This flexibility narrows down at the top of the third octave making it difficult to play these high tones in tune. The low tones "C_4", "D_4", and "E_4" are quite flat and on most instruments difficult for amateurs to play. The high "C_7" is practically an unmanageable tone to play in tune due to its inflexibility and sharpness. Since these tones are conditioned so strongly by the instrument, an amateur should be given careful guidance in the playing of these tones, and the director should realize that all the intonation difficulties are not necessarily inherent in the performer.

The chief difficulties which were revealed in the cornet and trumpet investigations were

caused by the internal tuning. Practically all tones played on the cornet and trumpet above "E_5" are tuned to sharp and in most cases it is impossible for the performer to bring these tones down to standard tuning. The "$C\#_4$" is much too sharp on all instruments, and in practically all cases cannot be played in tune. It is recommended that composers and arrangers avoid this tone in writing for these instruments. Careful training[1] and awareness of these intonation difficulties can alleviate the unfortunate conditions somewhat; however, it must be recognized that these difficulties are primarily caused by the internal tuning.

The clarinet investigations show that manufacturers should be more careful in the tuning of a clarinet, so that it is in tune at 72°F. The outward adjustment of the upper joint is quite disturbing to the internal tuning and should not be resorted to for any instrument which is properly built. If a performer has difficulty with some of the critical tones found on the clarinet, he should select a reed and mouthpiece combination which will make it easier to correct the deficiency. More attention should be given to the temperature of the room in which the band rehearses and plays, since various instruments are affected differently by temperature changes causing temporary intonation difficulties.

In selecting a clarinet extreme caution should be used in ascertaining the tuning of the "B_4" and "A_4" tones. The performer should see to it that the "B_4" is exactly in tune at 440 cycles in a 72°F. room temperature. The "throat tone" "A_4", which is usually too high, should be carefully checked. If a performer plays too flat with an open lay or medium lay mouthpiece, he should obtain a close lay mouthpiece to aid in correcting this deficiency. The sharpness of first register "throat tones" can be alleviated considerably by using a weak reed and an open lay mouthpiece.

It is recommended that clarinets of a band be made of the same material, that they be of high quality and that they be all of the same manufacture. It is of great consequence that the tuning level be correct without adjusting the upper joint and that the internal tuning pattern be the same for all the clarinets so that the various members in a section can easily play unisons.

[1] See bibliography (42). This monograph, published by The American Psychological Association, Inc., Northwestern University, Evanston, Illinois, should be a part of every music educator's library.

If all the clarinets in a section are made of the same materials and are in tune at 72°F., it is reasonable to assume that they will be in tune with each other at an 80°F. temperature level. Now if there is a discrepancy between the clarinets and other instrumental sections in a band caused by this temperature change, it is recommended that the other instruments be tuned to the clarinet section and that the entire group play at the new pitch level created by the temperature change.

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A SOCIAL ACCEPTANCE STUDY OF TRANSPORTED AND NON-TRANSPORTED PUPILS IN A RURAL SECONDARY SCHOOL

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Introduction

School days are generally recognized as an important factor in conditioning youth, by extending to them the opportunity to acquire such physical, mental, and social experiences as will best prepare them to meet the present and the future problems of citizenship.

Aside from the numerous studies that have had the tendency to indicate that pupils differ markedly in their inter-personal relationships, the writer was interested in arriving at a better understanding as to what these inter-personal bonds might be when comparing transported and non-transported pupils in a rural secondary school.

Do transported pupils who live in sparsely settled areas, travelling both to and from school each day, establish friendships as easily as non-transported pupils? Are transported pupils accepted socially in the classroom by those pupils who do not travel by bus? If we assume that the "sense of belonging" to a group or to a class is important, to what extent, may we ask, is this attribute acquired and shared among transported and non-transported pupils? Does the fact that transported pupils sometimes travel long distances to and from school have any particular bearing on their scholastic achievement as compared to non-transported pupils?

To add to the assumed importance of the problem, Works and Lesser have cited,[1] that over thirteen million pupils . . . roughly 50 per cent of all those in the United States . . . attend schools in rural areas. There are over 17,600 rural high schools, enrolling more than 2,200,000 pupils.

Butterworth describes the situation relative to pupil transportation, namely:[2] Relative to the status and growth of pupil transportation, a general picture of developments in this field from 1923-24 to 1939-40 has been given by the U. S. Office of Education. In the latter school year, over 4,000,000 pupils were transported at public expense in over 93,000 vehicles at a cost of over $83,000,000. The average annual cost was $20.10 per pupil transported. A later investigation by Butterworth and Snyder indicates[3] that the financial picture is one of steadily increasing costs, as would be expected from the general situation. National figures show increases as high as $10,000,000 in a year. State departments of education and state legislatures are becoming more interested in the financing of pupil transportation, both from the viewpoint of educational efficiency and of financial economy.

It has been generally assumed that transported pupils are affected relatively the same as non-transported pupils with regard to their being socially accepted by their classmates and in their scholastic achievement. The writer would like to know: Are they?

Due to the fact that the problems and difficulties of pupils who travel by bus are complex and render solutions extremely difficult, the present study was undertaken so as to secure some objective data which would assist the writer in answering these questions more accurately and with greater assurance. The problems and difficulties referred to in this instance are rainy days making roads impassable for transportation, mechanical b r e a k d o w n s of school buses, the lengthened school day for bus pupils, and inadequate provisions for extra-curricular activities due to bus schedules. Commissioner Studebaker has cited[4] the inequality of opportunity as particularly prominent in rural areas where overcrowded schools and inade-

* The writer wishes to acknowledge the assistance of Dr. Nelson B. Henry of the Department of Education, University of Chicago, for his timely suggestions and encouragement in the preparation of this article.

[1] Works, George A., and Lesser, Simon O. *Rural America Today*, (Chicago: University of Chicago Press, 1942), p. 23.

[2] Butterworth, Julian E. "Pupil Transportation," *Review of Educational Research*, XIII (October, 1943), pp. 359-362.

[3] Butterworth, Julian E., and Snyder, Edgar F. Transportation of Pupils," *Review of Educational Research*, XVI (October, 1946), p. 346.

[4] Excerpt from The Spotlight, *The School Executive*, 66 (October, 1946), p. 49.

quate curriculum are offered to "thousands of rural youth who still must travel long distances on their own or board out to reach such high schools."

Review of Literature

It has been stated by Havighurst and Davis that the past three years have been notable for an extensive application of sociometric techniques to the study of the social structure of school classes.[5]

Elliott has presented characteristic sociograms of a fifth-grade class and described some uses to which this kind of knowledge can be put by the classroom teacher. Kerstetter and Sargent observed with sociometric techniques the formation of a group of boys in a fifth-grade class which developed a delinquent pattern. When preventive measures were taken by seating members of this group so that they were dispersed among other groups, the boys became members of new groups and made a better social adjustment. Bonney studied the social structure of a second-grade and found that favored status was concentrated with a few pupils, that it was relatively stable, and that girls had a more favorable status than boys. Other studies by Barker, Hunt and Solomon, Zeleny, throw light on the individual's development of social status with his age mates.[6]

Northway was interested in children least acceptable in the group. Using the sociometric technique, studies were made of children listed in the fourth quartile. She found three distinct patterns: (1) The recessive child, (2) the socially uninterested child, and (3) the socially ineffective child.[7] Potashin studied the aspects of friendships using grades 5 through 7.[8] Seagoe, using 115 pairs of friends chosen from 823 children in grades 3 through 8, investigated the factors influencing the selection of friends. Evidence supported two principles, namely: (1) Propinquity is a strong factor in the selection of associates among children, and (2) similarity is more important than dissimilarity in the selection of associates.[9] Flotow studied the problem of the socially maladjusted child, using grades 4 through 8, consisting of 135 children. Identification of some of the major factors influencing social-status revealed that the personal relations within the home of the child were more important than were the social and the economic status of the family.[10] Kerr reports an experimental study of social acceptability carried on with children between nine and eleven years of age half-way through grade 5. Her findings listed several points as revealed by the analysis of her replies: (1) There was great variation in the responses with the nature of the question, (2) certain individuals showed marked changes on the second set of sociograms a year later, (3) there were significant differences in the choices made by boys and girls, (4) newcomers in the group each year were relatively low both in the number of times they were chosen and in their choices of others, and (5) before a child can be termed an isolate, various analyses of the material should be made.[11]

An interesting point of departure in studying the inter-personal relationships between boys and girls is an in-service training program especially designed for seventh and eighth grade teachers and others interested in personality development of children. This type of training was inaugurated in the state of Delaware some few years ago whereby each teacher would devote one period each week in giving a Human Relations lesson to his or her own pupils. The primary purpose seems to be to enable Delaware teachers to secure a good basic mental hygiene background. Courses are directed and supervised by the University of Delaware and the Delaware Society for Mental Hygiene. An outgrowth of the Human Relation's courses was a social acceptability test. This was administered to all seventh and eighth grade pupils and pointed to the conclusion that approximately one-third of the pupils in these classes are facing a "blackout" insofar as consideration is being given them by their fellows. The Committee further states that, if this condition is true throughout the country, a very serious problem is presented, a problem which must be solved if our way of life is to be really demo-

[5] Havighurst, Robert J., and Davis, Allison. "Child Socialization and the School," *Review of Educational Research*, XIII (February, 1943), pp. 29-37.

[6] Ibid., p. 33.

[7] Northway, Mary L. "Children With Few Friends," *The School* (January, 1944), pp. 382-383.

[8] Potashin, Reva. "A Sociometric Study of Children's Friendships," *Sociometry*, IX (February, 1946), pp. 48-70.

[9] Seagoe, May V. "Factors Influencing the Selection of Associates," *Journal of Educational Research*, XXVII (September, 1933), pp. 32-40.

[10] Flotow, Ernest A. "Charting Social Relationships of School Children," *Elementary School Journal*, XLVI (May, 1946), pp. 498-504.

[11] Kerr, Margaret. "A Study of Social Acceptability," *Elementary School Journal*, XLV (January, 1945), pp. 257-265.

cratic, for this test indicates that about one-third of our pupils in the schools in which tests are being given are not accepted by their classmates.[12]

The Problems

Specifically, the problems were twofold, namely: (1) To determine the inter-personal relationships between transported and non-transported boys and girls, and (2) to ascertain the scholastic achievement relationships between transported and non-transported boys and girls.

The Data

The subjects for this study consisted of 212 boys and girls from grade 7 through 12, of Dixie County High School, Cross City, Florida, conducted during the regular school year of 1945-46. The following Table I illustrates the distribution of transported and non-transported pupils for each grade level.

Table I

Transported and Non-Transported Pupils From Grade Seven Through Twelve

Grade	Transported Pupils	Non-Transported Pupils	Total No.
7	25	26	51
8	22	21	43
9	21	20	41
10	12	14	26
11	10	14	24
12	13	14	27
Total	103	109	212

Procedure

To measure the inter-personal relationships between transported and non-transported pupils, the writer personally visited each grade and distributed a questionnaire containing the following questions to be answered by the pupil: (1) The pupil's name, (2) whether or not the pupil was a transported or non-transported student, (3) the pupil's grade classification, and (4) each pupil was asked to answer the following question: Suppose you were to choose two of your best friends in this class, which two students would you prefer?

These data were next tabulated and sociograms were constructed for each grade level, dividing the pupils into four different categories, namely: (1) Transported boys, (2) transported girls, (3) non-transported boys, and (4) non-transported girls.

Five criteria were arbitrarily selected in comparing the inter-personal relationships of the pupils, namely: (1) Cliques, (2) isolates, (3) cross-sex choices, (4) honor credits, and (5) reciprocal choices of transported and non-transported pupils.

[12] The National Committee for Mental Hygiene, "A Social Acceptability Test," *Understanding the Child*, X (October, 1941), pp. 15-19.

In order to calculate the scholastic achievement for each pupil, five subjects were selected as the criteria, namely: English, social studies, science, mathematics, and physical education. The grades for these five subjects were taken from the Cumulative Guidance Record for the first semester of 1945-46.

The criterion, "honor credits," was determined for each pupil by transmuting the grades of the five subjects into numbers and then determining the mean:

A	5
B	4
C	3
D	2
F	−1

Discussion

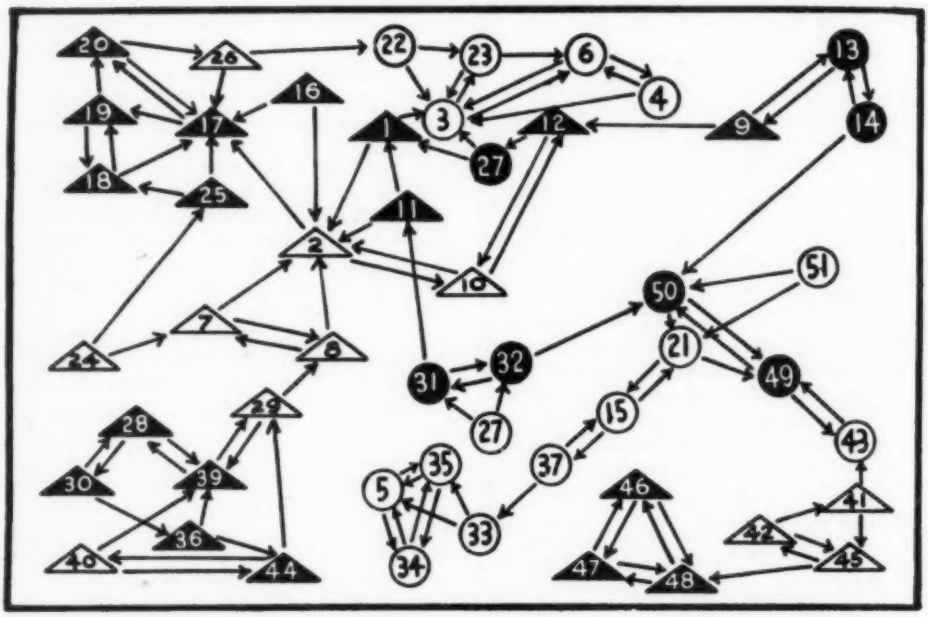
Reviewing Tables II through VII, one may discern that cliques predominate on each grade level, with the greatest number found in grade 9 and the least found in grade 11. In general, one might conclude that the proportion of cliques per class decrease from grade 7 through 12. The writer has assumed that a clique represents three or more pupils who have indicated reciprocal choices between each other.

Table VIII indicates that non-transported pupils contribute a greater number of pupils to cliques than do transported pupils, that is, when the combined total of pupils for each grade level is concerned. Actually, 65 per cent of the transported pupils and 64.2 per cent of the non-transported pupils contribute to the composition of cliques when each group is compared to the total number of its category. As a result, there appears to be no significant difference between either transported or non-transported pupils relative to the composition of cliques.

Isolates, or pupils who apparently have not been chosen by any of their classmates as a best friend, appear throughout each grade with the greatest number found in grade 10, when combining both transported and non-transported pupils, as shown by Table VIII. It is interesting to note that, of the total number of 103 transported pupils, 14 may be classified as isolates, while only 15 of the total number of 109 non-transported pupils are listed in the same category. In other words, these 29 isolates as found in a total of 212 pupils could have happened by chance alone in this instance, hence the assumption may well be that the difference of 1 isolate between transported and non-transported pupils is not statistically significant.

TABLE II

SOCIOGRAM OF FIFTY-ONE TRANSPORTED AND NON-TRANSPORTED BOYS AND GIRLS OF GRADE SEVEN INDICATING THEIR CHOICES OF BEST FRIENDS



● equals transported girl pupils.

▲ equals transported boy pupils.

○ equals non-transported girl pupils.

△ equals non-transported boy pupils.

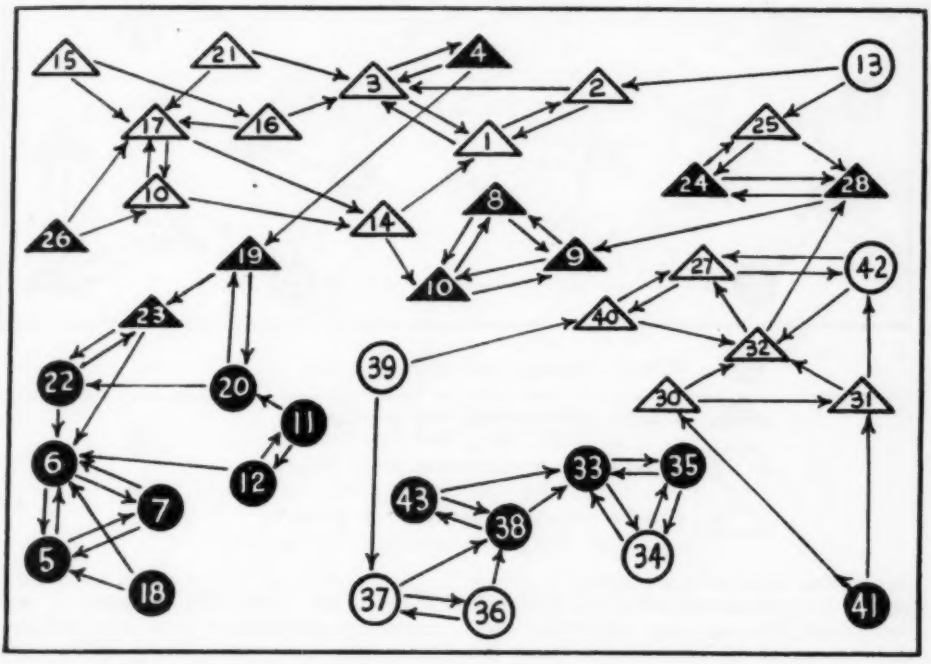
Table VIII indicates that, when comparing the total number of pupils on each grade level, grade 10 appears to have the greater number of frequencies as to isolates, with the least number found in grades 11 and 12.

Tables VIII and X indicate no appreciable difference between transported and non-transported pupils as to cross-sex choices, either when the groups are considered as a whole, or when comparisons are drawn as to sex. The greatest number of cross-sex choices tend to appear in grade 8.

When comparing transported pupils' choices of non-transported pupils as their best friend, Table XI indicates that both transported boys and girls of grade 10 rank the highest with 60 per cent and 85.7 per cent, respectively. On the other hand, non-transported pupils' choices of transported pupils as their best friend indicate that both non-transported boys and girls of grade 10, on the average, rank higher than any other grades, with 66.6 per cent and 62.5 per cent, respectively. This may appear contradictory to the figures in Table XI, as one

TABLE III

SOCIOGRAM OF FORTY-THREE TRANSPORTED AND NON-TRANSPORTED BOYS AND GIRLS OF GRADE EIGHT INDICATING THEIR CHOICES OF BEST FRIENDS



equals transported girl pupils.

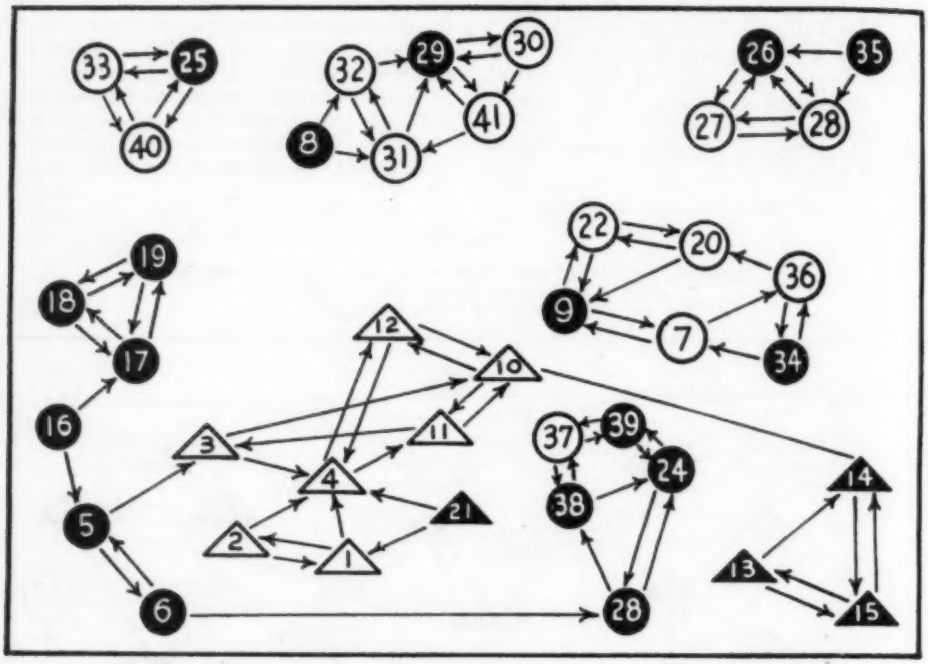
equals transported boy pupils.

equals non-transported girl pupils.

equals non-transported boy pupils.

TABLE IV

SOCIOGRAM OF FORTY-ONE TRANSPORTED AND NON-TRANSPORTED BOYS AND GIRLS OF GRADE NINE INDICATING THEIR CHOICES OF BEST FRIENDS



equals transported girl pupils.

equals transported boy pupils.

equals non-transported girl pupils.

equals non-transported boy pupils.

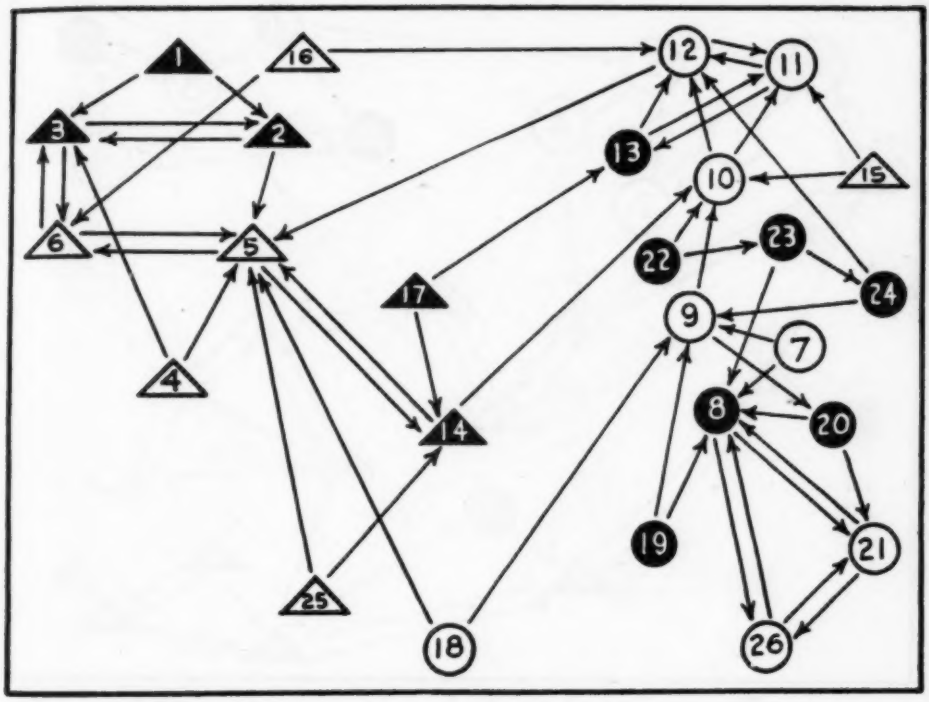
may see that all of the non-transported girls in grade 9 have chosen transported pupils as their best friends, but, one may additionally note, that not one of the non-transported boys has chosen a transported pupil as a best friend.

Concerning the comparison of mean honor credits between transported and non-transported pupils, Table XI indicates no significant difference between the two groups. When comparing the mean honor credits earned by transported and non-transported boys, Table XI shows that the greatest differences occur in grades 7 and 9, with non-transported boys having a margin of 3.8 and 5.4 points, respectively. A bar graph, Table XII, illustrates a supplementary comparison of transported and non-transported boys' mean honor credits from grade 7 through 12.

Comparing transported and non-transported girls as to the mean honor credits earned, one finds, according to Table XI, that transported girls in grade 7 are favored with a 2.2 point margin, while grade 11 non-transported girls have earned a margin of 5.1 points. The remaining grades are matched rather evenly as far as mean honor credits are concerned. The

TABLE V

SOCIOGRAM OF TWENTY-SIX TRANSPORTED AND NON-TRANSPORTED BOYS AND GIRLS OF GRADE TEN INDICATING THEIR CHOICES OF BEST FRIENDS



equals transported girl pupils.

equals transported boy pupils.

equals non-transported girl pupils.

equals non-transported boy pupils.

girls in each group, i. e., transported and non-transported, earn a greater number of honor credits, on the average, than do the boys for each respective group, the mean honor credits being 2.4 and 1.9 points, respectively. A bar graph, Table XIII, indicates supplementary information.

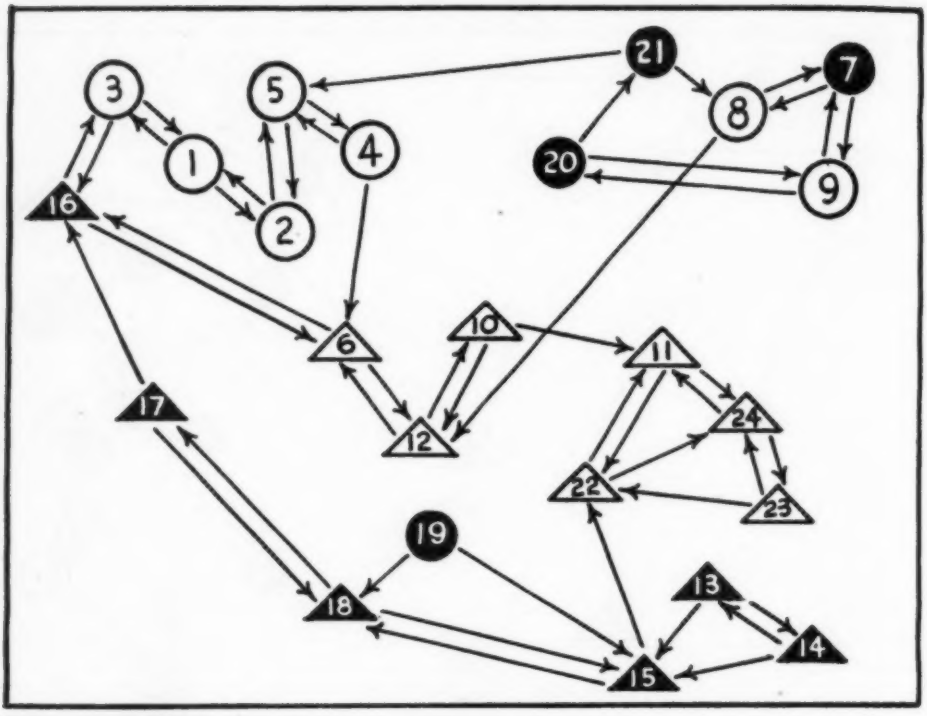
CONCLUSIONS

This study cannot be taken as conclusive or final. It is just a beginning. With this in mind, we can venture to suggest the following conclusions:

1. Cliques seem to appear on each grade level and their number somewhat propor-

TABLE VI

SOCIOGRAM OF TWENTY-FOUR TRANSPORTED AND NON-TRANSPORTED BOYS AND GIRLS OF GRADE ELEVEN INDICATING THEIR CHOICES OF BEST FRIENDS



equals transported girl pupils.

equals transported boy pupils.

equals non-transported girl pupils.

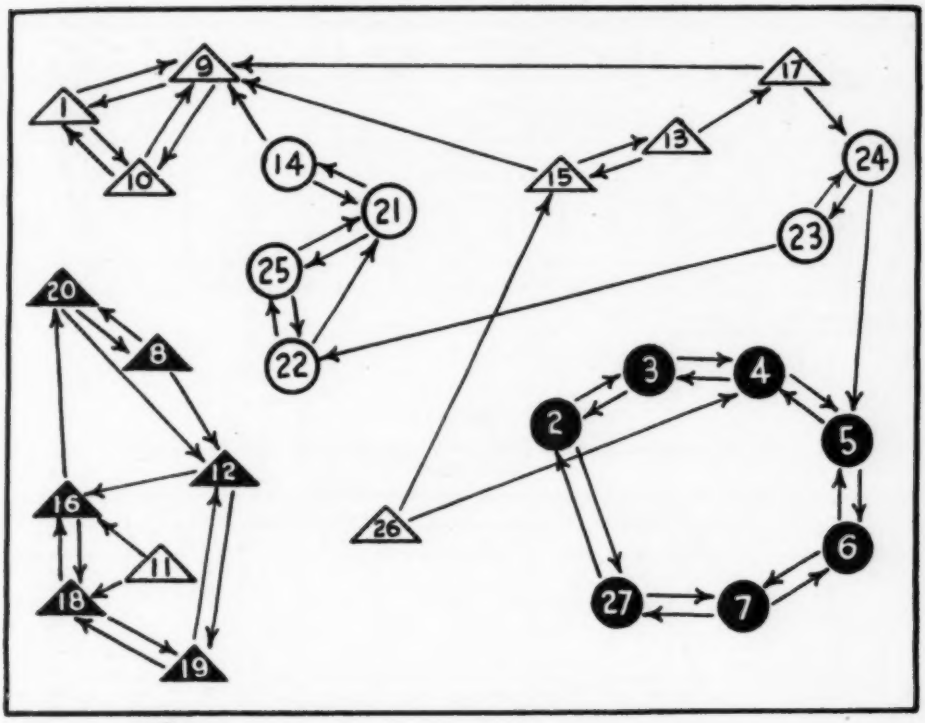
equals non-transported boy pupils.

tional to the number of enrollees. The early years of the junior high school appear to have a greater number of cliques accompanied by a gradual tapering off in the senior high school. According to this study, there are just as many cliques among non-transported as transported pupils.

2. Apparently, comparable isolates may be found among non-transported and transported pupils. No significant difference between the two groups seems to prevail.
3. No significant difference seems to manifest itself relative to cross-sex choices between non-transported and transported boys. The same situation exists among the girls.
4. Both non-transported and transported girls choose their best friends more often from transported and non-transported

TABLE VII

SOCIOGRAM OF TWENTY-SEVEN TRANSPORTED AND NON-TRANSPORTED BOYS AND GIRLS OF GRADE TWELVE INDICATING THEIR CHOICES OF BEST FRIENDS



equals transported girl pupils.

equals transported boy pupils.

equals non-transported girl pupils.

equals non-transported boy pupils.

pupils, 17.6 per cent and 10.1 per cent, respectively, in excess of non-transported and transported boys.

5. In general, there appears to be no appreciable difference between the mean honor credits earned by transported and non-transported boys, or between transported and non-transported girls. The highest mean honor credits were invariably scored by both transported and non-transported girls.
6. According to this study, the effect of transportation as a factor in influencing the number of cliques, isolates, cross-sex choices, reciprocal mutual friendships, or scholastic attainment appears to be negligible.

TABLE VIII

A COMPARISON OF CLIQUES, ISOLATES, AND CROSS-SEX CHOICES BETWEEN TRANSPORTED AND NON-TRANSPORTED PUPILS

Grade	No. of Pupils		No. of Pupil Cliques	Composition of Pupil Cliques		No. of Pupil Isolates		Per Cent of Total		No. of Cross-Sex Choices		Per Cent of Total	
	T[1]	N[2]	T+N	T	N	T	N	T	N	T	N	T	N
7	25	26	7	15	16	1	3	4.0	11.5	6	2	24.0	7.7
8	22	21	7	13	18	3	4	13.6	19.0	5	5	22.7	23.8
9	21	20	8	17	18	4	0	19.0	...	1	0	4.8	...
10	12	14	3	4	6	4	6	33.3	42.9	2	4	16.7	28.6
11	10	14	2	5	4	2	0	20.0	...	2	3	20.0	21.4
12	13	14	4	13	8	0	2	...	14.3	0	3	...	21.4
Total	103	109	31	67	70	14	15	13.6	13.8	16	17	15.5	15.6

[1] Indicates transported pupils.
[2] Indicates non-transported pupils.

TABLE IX

A COMPARISON OF ISOLATES BETWEEN TRANSPORTED AND NON-TRANSPORTED BOYS AND GIRLS

Grade	Transported Pupils		Non-Transported Pupils		Total
	Boys	Girls	Boys	Girls	
7	1	0	1	2	4
8	1	2	2	2	7
9	1	3	0	0	4
10	2	2	4	2	10
11	0	2	0	0	2
12	0	0	2	0	2
Total	5	9	9	6	29

TABLE X

A COMPARISON OF CROSS-SEX CHOICES BETWEEN TRANSPORTED AND NON-TRANSPORTED BOYS AND GIRLS

Grade	Transported Pupils		Non-Transported Pupils		Total
	Boys	Girls	Boys	Girls	
7	3	3	2	0	8
8	2	3	2	3	10
9	0	1	0	0	1
10	2	0	2	2	6
11	1	1	0	3	5
12	0	0	2	1	3
Total	8	8	8	9	33

TABLE XI

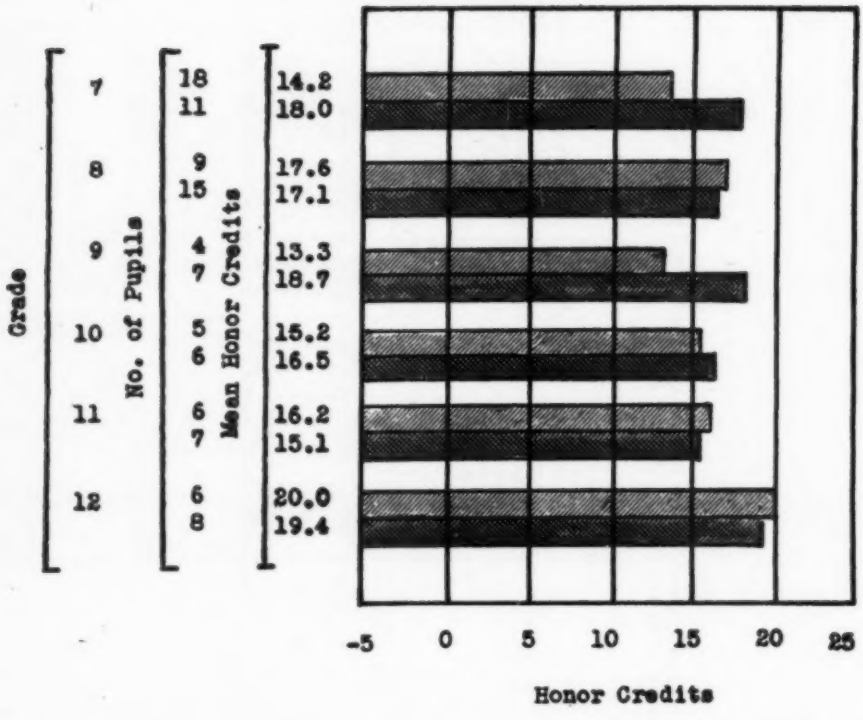
COMPARISON OF NUMBER, PER CENT OF CHOICES OF BEST FRIENDS, AND MEAN HONOR CREDITS BETWEEN TRANSPORTED AND NON-TRANSPORTED PUPILS

Grade	No. of Pupils	No. of Transported Pupils		No. of Non-Transported Pupils		No. of Transported Pupils' Choices of Non-Transported Pupils as Best Friends		Per Cent		No. of Non-Transported Pupils' Choices of Transported Pupils as Best Friends		Per Cent		Mean Honor Credits of Transported Pupils*		Mean Honor Credits of Non-Transported Pupils*	
		B	G	B	G	B	G	B	G	B	G	B	G	B	G	B	G
7	51	18	7	11	15	7	3	38.9	42.9	7	4	63.5	26.7	14.2	21.0	18.0	18.8
8	43	9	13	15	6	3	3	33.3	23.1	4	3	26.7	50.0	17.6	20.9	17.1	23.5
9	41	4	17	7	13	2	10	50.0	58.8	..	13	...	100.0	13.3	16.4	18.7	15.9
10	26	5	7	6	8	3	6	60.0	85.7	4	5	66.6	62.5	15.2	17.9	16.5	18.3
11	24	6	4	7	7	2	3	33.3	75.0	1	2	14.3	28.6	16.2	15.0	15.1	20.1
12	27	6	7	8	6	..	..	...	...	2	1	25.0	16.7	20.0	19.6	19.4	20.0
Total	212	48	55	54	55	17	25	35.4	45.5	18	28	33.3	50.9	16.1	18.5	17.5	19.4

* Includes English, social studies, science, mathematics, and physical education.

TABLE XII

A COMPARISON OF TRANSPORTED AND NON-TRANSPORTED BOYS' MEAN HONOR CREDITS*



* Includes English, social studies, science, mathematics, and physical education.

▨ equals transported boys.

▨ equals non-transported boys.

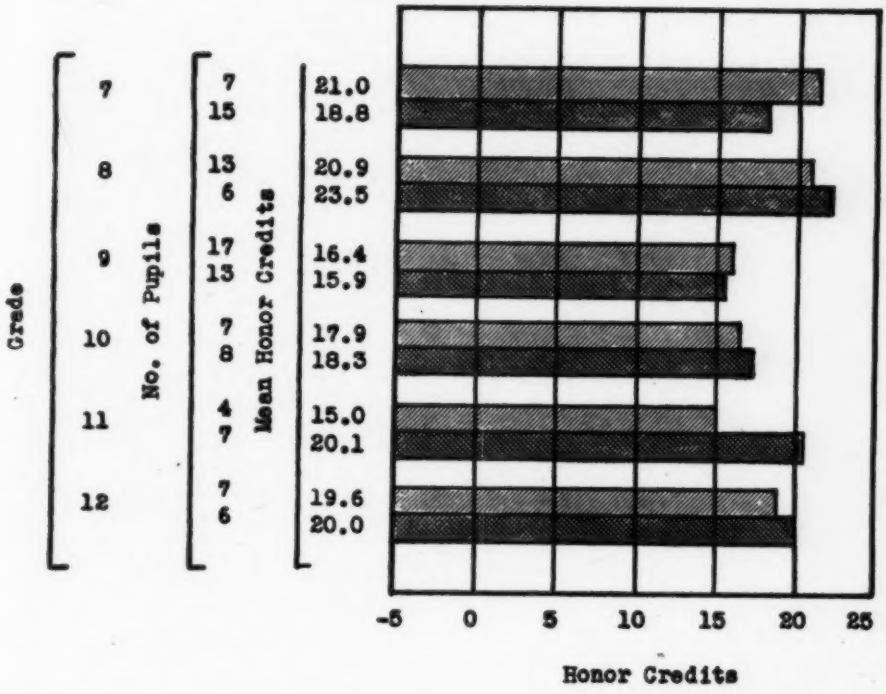
RECOMMENDATIONS

These data can do no more than suggest probabilities, hence a future study might include:

1. The selection of a comparable group to be tested over a given length of time, using the initial data as a basis for evaluation in the later survey.
2. Possibly, a series of questions, in contrast to a single question, as related to interpersonal relationships would greatly enhance the value of the study.
3. It is quite possible that extraneous factors, which have been overlooked, have entered this study, which have had the tendency to influence the relationships as derived, hence a future study might resort to the use of the correlation method.

TABLE XIII

A COMPARISON OF TRANSPORTED AND NON-TRANSPORTED GIRLS' MEAN HONOR CREDITS*



*Includes English, social studies, science, mathematics, and physical education.

▨ equals transported girls.

▩ equals non-transported girls.

A STUDY OF SOME MEANS OF PRESENTING INFORMATION TO PARENTS ABOUT THE SCHOOL HEALTH PROGRAM

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PURPOSE AND PROCEDURE

The purpose of the investigation was to study the effectiveness of some selected devices for presenting information about the school health program to parents. Among the instruments specifically included in the analysis were parent bulletins, radio programs, newspaper advertisements, window exhibits, health shorts at commercial theatres and parent questionnaires on health topics.

Certain of the techniques of public health education were employed in disseminating health information to the parents of specific groups of pupils, with the eventual evaluation based largely on the effectiveness of the implements in influencing the health behavior of the pupils concerned. This judgment was taken with thoughtful regard of the difficulties involved. Studies have pointed out significant differences between what we know about health and what we do about it.[1] It has also been shown that health education programs may bring about decided gains in knowledge without materially affecting health practices.[2] Other procedures such as newspaper articles, parent-teacher meetings, nurse home visits, and home discussion of the school health experiences were not introduced as variables because of prior use. However, they were given indirect treatment for comparative purposes.

Specific questions it seemed possible to answer are as follows:

1. Which of the devices used is most effective in reaching the home with selected health information?
2. What is the attitude of parents toward the presentation of health information to the home through the various devices?
3. Is there a significant change in the health habits of the children following the use of the devices?

[1] W. H. Southworth, J. V. Latimer and C. E. Turner, "A Study of Health Practices, Knowledge, Attitudes and Interest of High School Pupils." *Research Quarterly of the American Association for Health and Physical Education*, May 1944, 119.

[2] L. Gold, "Changing Student Food Habits Through the School Program." *Journal of School Health*, January 1945, 8.

The parent bulletins were those contained in the Parents Leaflet Series of the Wisconsin Cooperative School Health Program.[3] Subjects covered were: Good Vision is Important; Good Hearing is Essential; Safeguard Your Child's Teeth; When to Keep Children Home; Food for School Girls and Boys. A series of twelve radio transcriptions obtained from the American Medical Association were broadcast at weekly intervals over the local radio station. Program discussion topics included bacteria and disease, immunization, the common childhood diseases, quarantine values, home nursing and care of the patient and the common cold.

A full page, well illustrated newspaper advertisement setting forth the objectives and purposes of the school health program was published in the daily newspaper. A local advertising agency contributed to the development of the ad and costs were defrayed by twenty-six of the retail credit division members of the Chamber of Commerce. A window exhibit in a downtown store portrayed the school health program and pointed out its aims. Two short thirty-five millimeter films on nutrition, namely: Proof of the Pudding and Something You Didn't Eat were rotated for three day showings among the four commercial theatres. A parent-questionnaire was sent to the homes at the beginning and the end of the study. The questionnaire was framed with a positive emphasis and designed to stimulate parents towards encouragement of desirable pupil health behavior.

Every effort was made to develop the program for dissemination of health information to parents in a planned, continuous and coordinated manner. Many individuals and groups contributed to the initiation, planning, carrying out and evaluation of the investigation.

A study of reports of related experiences disclosed that public health workers have made considerable use of a variety of similar procedures in programs for general health education.

[3] Wisconsin State Board of Health, "Parent Leaflet Series." Bureau of Maternal and Child Health, Madison, Wisconsin, 1944-1946.

However, few instances could be found of the utilization of such methods, by school health authorities, for the purpose of harmonizing the influences of the home and the school.

In the investigation, which was of the field-study type, a semi-controlled technique of research was employed under normal classroom conditions. Pupils of the fourth, fifth, and sixth grades together with their teachers and parents were included in the study.

Ten elementary schools in the city of Oshkosh, Wisconsin, which has a population of approximately forty thousand people, were involved in the investigation. Three six-teacher schools, two nine-teacher schools, one ten-teacher school, two eleven-teacher schools, and one twelve-teacher school were included. Enrollment varied from 141 to 429 and the average pupil load was 27.6.

The typical pupil who participated in the study could be described as a boy or girl of about 10.2 years of age. The possible age range varied from 9 to 13 while the per pupil cost for the 1945-1946 school year was $123.66. Some eight hundred pupils and thirty teachers participated in the study. Teachers involved in the investigation were all women with an average age of 44.4 and had taught for an average period of 17.3 years. The representative teacher received a salary of $1,963 and had 4.07 years of professional training beyond high school.

The vast majority of parents had completed the eighth grade and a large proportion were high school graduates. The general socio-economic status of the people lies between the upper and lower middle classes with comparatively few examples of great wealth or extreme poverty. The average parent is a somewhat conservative and thrifty individual who, however, has a real interest in good schools and is vitally concerned with the welfare of his children.

The experimental procedure which appeared most suitable for purposes of this investigation involved the following steps:

1. The use of the entire population of the classes and schools concerned as an experimental group.
2. Measurement of the initial status of the pupils in respect to certain aspects of health behavior.
3. Employment of only the regular instructional program for a stipulated period of time.
4. Measurement of the status of pupils at the end of the designated time interval.
5. Application of the treatment or devices along with the regular instructional program for an equal period of time.
6. Re-evaluation and comparison of changes in health behavior of pupils during the two equated periods.

The procedure permitted measures of the mean status of pupil health behavior before and after "treatment."[4]

The evaluation techniques employed were questionnaires, oral examinations, interviews and observations. Changes in pupil health behavior were measured in terms of health practices executed the preceding day.[5] Further evaluation of the devices was obtained through interviews with the parents and teachers intimately involved in their use. Wherever feasible, direct observation of the reaction and response to the implements was included as an additional estimate of their worth.

The following precautions were taken to control as far as possible other factors which might make their impression on pupil health behavior:

1. The subjects employed in the investigation were chosen from definite types of schools and homes; namely, fourth, fifth and sixth grade pupils enrolled in the city grade schools of Oshkosh. All pupils were participants in the school health program.
2. The classes chosen were all from non-departmentalized schools with the same teacher providing all instruction.
3. The supervisors of health and physical education made the same number of visits to each school during the two periods of the study.
4. The same supplementary health readers were used during both phases of the investigation, while two twenty-five minute periods were devoted to specific health instruction each week.
5. An attempt was made to provide the same amount of integrated instruction, special projects such as field trips and other activities, during both periods.
6. No additional visuals aids, reading materials or other equipment were furnished

[4] E. F. Linquist, "Statistical Analyses in Educational Research." Houghton, Mifflin Company, Boston, 1940, 58-59.

Journal of School Health, 13:1, January 1943, 9-17.

[5] C. E. Turner, "Significant Findings of the Massachusetts High School Study and Implications for Health Education."

during the second interval that were not also previously available.

7. Time used for discussion or follow-up of the various devices was subtracted from that devoted to health instruction.

In general, the analysis of the data involved three steps. First, tabulations of frequencies and percentile changes for the various items were made. Secondly, contingency tables were constructed and "Chi Square" calculated in relation to the shifts which had occurred for the total response in each case. Finally, proportions derived from a comparison of desirable and undesirable reactions within each category were developed and the test to determine the "Significance of a Difference between Two Proportions" was applied. In instances where this procedure appeared inappropriate, for example, in the rating of the various devices by teachers and parents, a process of determining the total weighted value and the weighted mean value was utilized.

The Findings

A list of fifteen health practices arbitrarily selected partly on the basis of local teacher-committee reports on existing health problems and partly as a result of a review of a state-wide study of health practices of school children was developed.[6] Items included elements related to adequate nutrition, exercise, rest, the use of preventive and therapeutic medical services and the avoidance of excesses.

[6] O. E. Byrd, "Health Instruction Yearbook." Stanford University Press, 1944, 247-248.

Pupil Health Behavior Items

1. Secured dental care or check-up during the past six months.
2. Brushed teeth before coming to school in the morning.
3. Used at least one glass of milk with the last meal.
4. Used a quart of milk the previous day.
5. Used no coffee on the previous day.
6. Had at least ten hours of sleep last night.
7. Had at least an hour of outdoor play yesterday.
8. Had green and yellow vegetables the previous day.
9. Had fruit or fruit pieces the previous day.
10. Took fish liver oil of some type the previous day.
11. Washed hands before eating the last meal.
12. Washed hands after last visit to toilet.
13. Ate no candy between meals the previous day.
14. Had no soft drinks between meals the previous day.
15. Has kept height and weight chart up-to-date.

The first step in the analysis was to compare the frequencies of performance of health habits at the initiation, midpoint and completion of the investigation. The tabulations obtained through the use of a modified form of the "Health Habits Executed Yesterday" technique produced the results indicated in Table I.

Table I

Frequencies of Pupil Performance of Health Habits
Initial, Midpoint and Final Tabulations

Practice	September		February			June		
	f	%	f	%	change	f	%	change
1.	383	44.7	356	41.8	−2.9	418	51.3	9.5
2.	402	47.0	391	45.9	−1.1	458	56.2	10.3
3.	677	79.1	637	74.9	−4.2	682	83.7	8.8
4.	690	80.6	651	76.4	−4.2	678	83.2	6.8
5.	743	86.8	692	81.3	−5.5	686	84.2	2.9
6.	614	71.7	617	72.5	.8	692	84.9	12.4
7.	724	84.6	689	80.9	−3.7	776	95.2	14.3
8.	581	67.9	598	70.2	2.3	710	87.1	16.9
9.	656	76.6	642	75.4	−1.2	641	78.6	3.2
10.	165	19.3	229	26.9	7.6	292	39.8	12.9
11.	673	78.6	652	76.6	−2.0	685	84.0	7.4
12.	650	75.9	651	76.4	.5	695	85.3	8.9
13.	431	50.3	507	59.6	9.3	538	66.0	6.4
14.	661	77.2	728	85.6	6.4	670	82.2	−3.4
15.	776	90.7	737	86.6	−4.1	728	89.3	2.7
	M	68.7	M	68.7	.00%	M	76.7	8.0%
	856 Cases		851 Cases			815 Cases		

Differences in number of cases are accounted for by absences due to illness and fluctuation in school enrollment from other causes. Inspection of Table I reveals a mean gain of 8.0 after the introduction of the devices with an increase in respect to fourteen items and a negative recording in only one. In the previous equated period there was relatively little individual variation and no mean change, but there was a small negative shift for nine of the items, and a positive change for six! An interesting picture of the changes that occurred is graphically represented in Figure I.

The question then arises as to whether or not these variations are larger than can be attributed to chance or are indicative of real differences in the performances of health habits from period to period. For testing the homogeneity of the responses to the items X^2 (Chi Square) was employed which may be defined as

$$X^2 = \Sigma \frac{(f_o - f_t)^2}{f_t}$$

in which f_o represents the observed frequency in a single category, f_t the corresponding or hypothetical frequency and in which the Σ indicates that the terms $(f_o - f_t)^2/f_t$ are to be summed for all categories.[7]

For purposes of this analysis the exact algebraic equivalent of the formula above was employed, which is illustrated in the example shown below.[8]

SECURING DENTAL CARE

	Desirable Responses	Undesirable Responses	Total	R^2/T
September	383	473	856	171.4
February	356	495	851	148.9
June	418	397	815	214.4
	Σ1157	Σ1365	Σ2522	534.7

$$p = \frac{1157}{2522} = .459;\ q = .541;\ pq = .248319$$

$$X^2 = \frac{1}{.248319}(534.7 - 1157 \times .459) = 14.50$$

$$P\ (X^2 \} 14.5) = \text{less than } 1\%$$

Table II shows the X^2 thus obtained for each of the fifteen health practices. The P was secured by references to the X^2 Table, and indicates the probability of getting a value as great as or greater than X^2 due to chance.[9]

TABLE II

CHI SQUARES AND PROBABILITY PERCENTAGES FOR FIFTEEN HEALTH PRACTICES

Item	X^2	D. F.	$P(X^2 N)$
1	14.5	2	Less than 1%
2	21.2	2	Less than 1%
3	24.8	2	Less than 1%
4	6.3	2	Approx. 3%
5	9.7	2	Less than 1%
6	55.0	2	Less than 1%
7	79.4	2	Less than 1%
8	96.3	2	Less than 1%
9	10.7	2	Less than 1%
10	57.6	2	Less than 1%
11	14.2	2	Less than 1%
12	33.3	2	Less than 1%
13	43.7	2	Less than 1%
14	26.0	2	Less than 1%
15	21.1	2	Less than 1%

It will be readily seen that in all cases except item four we can reject the hypothesis of homogeneity of response at least at the 1% confidence level. Stated in application to our data we may say that the probability of the differences obtained being due to chance is less than one per cent for fourteen of the fifteen items.

A third step in the analysis was to determine through appropriate procedure whether or not the differences secured for the specific health practices were statistically significant. For this

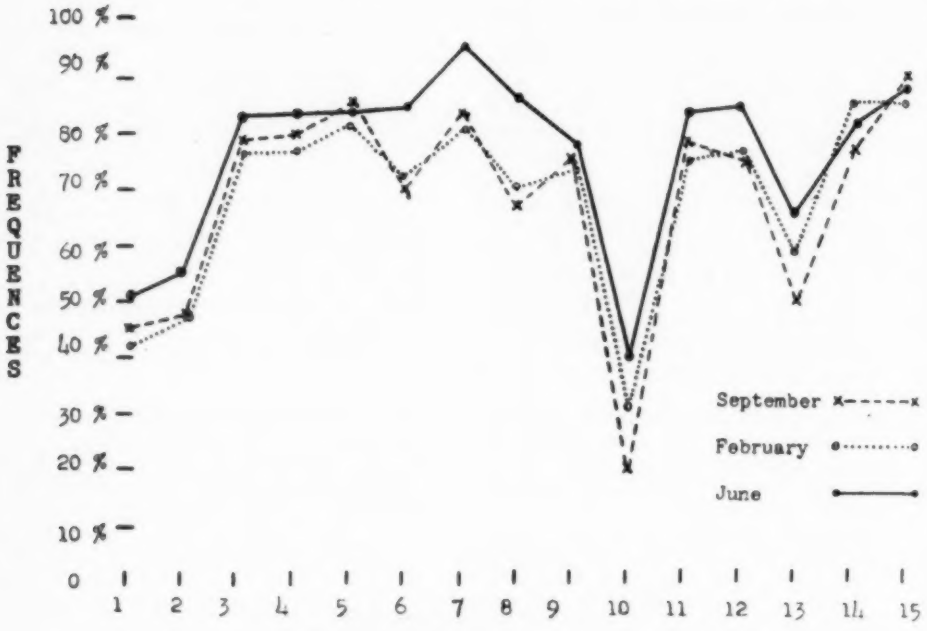
[7] E. F. Linquist, "Statistical Analysis in Educational Research," Houghton-Mifflin Company, Boston, 1940, 31.

[8] Ibid, 44-45.

[9] Op. Cit. 36.

FIGURE I

Frequencies of Pupil Performance of Health Habits
Initial, Midpoint and Final Tabulations



purpose it was decided to utilize the procedure termed "Testing the Significance of the Difference Between Two Proportions." Proportions were developed for the two periods, September to February and February to June, using in each case the desirable responses as the numerator and the undesirable responses as the denominator. The following formulas were employed.[10]

$$p^1 = \frac{N_1 p_1 + N_2 p_2}{N_1 + N_2}$$

$$X = \frac{p_1 - p_2}{(p'\,q')^{1/2}(1/N_1 + 1/N_2)^{1/2}}$$

Consulting the tables of probability for the normal curve, in respect to the critical ratio thus obtained, provides an indication of the percentage of probability of a deviation as great as or greater than that secured.[11] The value is doubled to provide for occurrence at both tails of the curve and will be termed 2P. Table III shows the values obtained through the procedure described above and their position in relation to the probabilities of the normal curve.

A perusal of the Table III quickly acquaints us with the fact that during the period from September to February we have five differences that can be regarded with a high degree of certainty as statistically significant, while in two other cases we can be reasonably sure that a real difference does exist. In respect to four of the items, however, the differences secured are of a negative nature. On the other hand, within the period between February and June we find significant changes occurring in ten of the items, none of which is negative. In respect to two others we can feel relatively sure that a difference not attributable to chance has occurred, but one of these deviations is negative. The in-

[10] P. R. Rider, "Modern Statistical Methods," John Wiley and Sons, London, 1939, 82.
[11] Ibid, 194-197.

TABLE III

SIGNIFICANCE OF THE DIFFERENCE BETWEEN PROPORTIONS OF DESIRABLE RESPONSES FOR THE TWO EQUATED PERIODS

Item	September to February		February to June	
	X	2P(YN)	X	2P(YN)
1	−1.25	.2112	3.67	.0002
2	− .41	.6818	4.08	.0000
3	−1.96	.0500	4.54	.0000
4	−2.51	.0120	3.53	.0004
5	−3.38	.0008	1.61	.1074
6	.46	.6456	6.44	.0000
7	−1.63	.1032	8.76	.0000
8	.89	.3734	8.42	.0000
9	− .97	.3320	1.94	.0524
10	3.92	.0000	3.94	.0000
11	− .99	.3174	3.60	.0004
12	.00	1.0000	4.63	.0000
13	3.75	.0002	2.53	.0114
14	4.78	.0000	−2.22	.0264
15	−2.64	.0082	1.25	.2112

terpretations given above are based upon a high degree of certainty at better than the one per cent level and reasonable surety on items at better than the five per cent level.

PARENTAL QUESTIONNAIRES

Parental questionnaires covering similar health behavior elements but combining some of the health practice items for the sake of conciseness were sent to the homes of pupils in February and June. Except for the introductory statement both questionnaires were identical. In February, 810 of 833 questionnaires were returned, while in June, 768 from among 801 were brought back to the school. Parents were requested not to identify themselves in the interests of veracity. Small gains were recorded for all of the items with the greatest gain amounting to 15%.

PARENT QUESTIONNAIRE ITEMS

MY CHILD

1. Has at least ten hours of sleep on school nights.
   __Always __Usually __Seldom __Never
2. Uses a quart of milk each day as a drink or in other foods.
   __Always __Usually __Seldom __Never
3. Brushes teeth at least twice each day.
   __Always __Usually __Seldom __Never
4. Plays at least one hour outdoors each day except in very bad weather.
   __Always __Usually __Seldom __Never
5. Avoids coffee and other stimulants.
   __Always __Usually __Seldom __Never
6. Eats fruit or fruit juices and green or yellow vegetables each day.
   __Always __Usually __Seldom __Never
7. Washes hands before eating and after going to the bathroom.
   __Always __Usually __Seldom __Never
8. Takes some type of fish liver oil each day.
   __Always __Usually __Seldom __Never
9. Has been to the dentist for examination, cleaning or repair of teeth during the last
   __6 Mos. __Yr. __18 Mos. __2 Yrs.
10. Uses candy and soft drinks only after meals as a dessert.
    __Always __Usually __Seldom __Never

In further analysis of results to determine whether factors other than chance were operative in the changes which took place, the X^2 (Chi Square) procedure as previously described was utilized. Critical ratios and "2P" were also calculated to determine if a real difference existed between the February and June tabulations for each item. Table IV includes the Chi Square and Critical Ratio in respect to parental opinion of pupil health behavior. In setting up the contingency tables for determination of X^2, responses were treated individually. In developing proportions for determining critical ratios the Always and Usually, and the Seldom and Never reactions were summed as desirable and undesirable responses respectively.

TABLE IV

CHI SQUARES, CRITICAL RATIOS, APPROX. Ps AND 2Ps
PARENTAL QUESTIONNAIRE ON PUPIL HEALTH HABITS
FEBRUARY AND JUNE

Item	X^2	D.F.	P Approx.	CR	2P
1	4.40	3	22%	1.68	.0930
2	2.80	3	43%	1.69	.0910
3	4.00	3	27%	1.20	.2302
4	71.25	3	—1%	1.76	.0784
5	40.83	3	—1%	4.94	.0000
6	3.20	3	54%	3.36	.0008
7	4.00	3	27%	0	1.0000
8	13.61	3	—1%	.40	.6892
9	27.20	4	—1%	3.63	.0002
10	30.20	4	—1%	4.74	.0000

We can readily see by checking Table IV that in four cases we may with a high degree of confidence reject the hypothesis that the differences obtained were due to chance. In three other cases it will be noted that the probability of the differences being significant was over ninety per cent, although in these instances the deviation probability is considerably greater than the five per cent confidence level. A comparatively small number of parents attached fifty-nine comments. Of these, fifty-seven were favorable and two unfavorable.

SUMMARY OF RADIO LISTENING

A contingency table depicting the results obtained in analysis of the data secured through a telephone survey of parents radio listening to the health broadcasts was constructed and appears below.

During the course of the survey 209 telephone calls were made to 45 parents in the former category and 120 calls to 27 homes in the latter. The differences in number of cases developed from a lack of telephones in the homes of many of the pupils listed as having poor health habits.

Through the procedure previously described in reference to "Parent Questionnaires" and "Pupil Health Behavior Measures," the "Chi Square" and "Significance of a Difference Between Two Proportions" were calculated. The results appear below.

$X^2 = 2.23$; K=2, $P(X^2 \geq 2.23)$ = Approx. 35%
X=.739; $2P(\geq .739) = .4592$

It is thus evident that there is no significant difference between the yes responses of the two groups concerned, with the probability of ob-

TABLE V

PARENTS LISTENING TO HEALTH BROADCASTS

Preference Category	Group A (45)		Group B (27)	
	f	%	f	%
Listening	34	16.3	16	13.3
Not Listening	153	73.2	85	70.8
No Response	22	10.5	19	15.8

"Group A" above refers to parents of pupils with good health habits, and "Group B" to parents of pupils with poor health habits. Groupings were determined through the subjective judgment and observation of teachers.

taining a deviation greater that secured running over 80%. It is also demonstrated that sixty-five times out of a hundred the differences obtained would have occurred through change alone.

Health Exhibit Evaluation

In studying the effectiveness of the Health Exhibit, observers and their reactions were recorded from 8 A. M. to 8 P. M. on one of the six days during which the display remained in a downtown store window. The number of individual onlookers was 701, while thirty-three observers were timed to the nearest minute in respect to time spent reading the legends. In Table VI the recorded reactions of the raters are summarized.

Table VI

Rating of Observers' Reaction to Health Exhibit

Rater	Observers N	Time Spent M	Longest Time Spent
1	56	1	3
2	118	2	20
3	82	1	10
4	80	1	3
5	102	1	2
6	101	1	4
7	43	2	7
8	41	2	5
9	19	1	3
10	34	1	3
11	125	1	4
	Σ701	Σ14	Σ64
	M 63.7	M 1.27	M 5.82

It will be noticed that the mean number of observers during an hourly period was 63.7, who spent an average of 1.27 minutes inspecting the exhibit, with the limited range of from 1 to 2 minutes. The range recorded for longest time spent was from 2 to 20 minutes with a mean of 5.82 minutes.

A further analysis of the date involved a comparison of the time spent by thirty-three randomly selected observers in reading the legend with the reading time actually required as disclosed by a study of twenty-four junior high school pupils. Table VII reveals the comparative values established in this analysis.

The concentration of frequencies of pupils, who read all legends, around the mid-area of the table as compared with the observers' frequencies grouped at the top of the table vividly illustrates the discrepancy between the time required to read all legends and that actually spent. This fact is also borne out by inspection of the means, which are 9.75 for the pupils and 3.55 for observers.

Table VII

Comparison of Time Spent Reading Legends by Thirty-three Randomly Selected Observers and Twenty-four Junior High School Pupils

Minutes t	Pupils f	Pupils tf	Observers f	Observers tf
1			12	12
2			5	10
3			5	15
4			4	16
5	1	5	1	5
6	2	12	1	6
7	2	14	1	7
8	3	24	2	16
9	3	27	0	
10	4	40	1	10
11	3	33		
12	2	24		
13	2	26		
14	1	14		
15	1	15		
16				
17				
18				
19				
20			1	20
	Σ24	Σ234	Σ33	Σ117
		M 9.75		M 3.55

Rating of Devices by Teachers

After the devices had been used by the teachers in the schools and grades concerned, it was thought important to gather teacher opinion on their effectiveness. Teachers rated the procedures employed together with two additional methods used in preceding years.

Scores given to the various devices were weighted by multiplying the frequencies for each item by the place weight and then summing the values to determine the weighted total for each item. The resultant was then divided by the summed frequencies, to secure the weighted mean. The formula for this process is given below.

$$M_n = \frac{\Sigma(P_t \times P_n)}{F_t}$$

The rank for each implement was there established upon inspection of the relative position of the weighted means. Items rated are listed below together with Table VIII which presents a summary of the data.

1. Parents' Bulletins on Various Aspects of Health.
2. Parent-Teacher and Other Meetings Devoted to Health.
3. Newspaper Advertisements on Health.

4. Movie Shorts on Health at Commercial Theatres.
5. Radio Programs on Health Topics.
6. Window Exhibits on Health in Downtown Stores.
7. Newspaper Articles on Health.
8. Parent Questionnaires Emphasizing Desirable Health Habits.

TABLE VIII

RANK GIVEN BY TEACHERS TO DEVICES FOR PRESENTING HEALTH INFORMATION TO PARENTS

Item	Weighted Total	Weighted Mean	Rank
1	221	6.14	2
2	131	3.64	6
3	113	3.14	7
4	173	4.81	3
5	162	4.50	4
6	113	3.14	7
7	152	4.22	5
8	234	6.50	1

"Parents' Questionnaires" and "Parents' Bulletins" rated first and second respectively with only a slight difference in weighted means. Further study of Table VIII discloses that teachers felt that four of the devices used in the study were superior to newspaper articles and parent-teacher meetings on health, for effectively presenting health information to parents.

PARENTAL INTERVIEW ANALYSIS

Forty randomly selected parents were interviewed in their homes to determine parental reaction to the use of the various devices. All ten school districts were included with four parents being interviewed in each area.

Table IX shows the frequency and percentage values given the various instruments by parents. Parent preferences were secured in terms of the individual devices which they considered most effective.

TABLE IX

	f	%
Parents Bulletins	11	27.5
Question Blanks	15	37.5
Health Movies	1	2.5
Radio Programs	7	17.5
Health Meetings	1	2.5
Health Exhibits	0	0.0
Newspaper Ads	0	0.0
Newspaper Articles	5	12.5

A comparison of parent and teacher opinion as to the effectiveness of the various devices seemed a valuable supplementary process. For this purpose a contingency table was constructed around the frequencies of the parental ratings and the weighted total of the values given by teachers. In the latter cases the product for each item was divided by ten and rounded off. The resulting comparative tabulation is shown below.

TABLE X

COMPARATIVE RATING OF DEVICES BY PARENTS AND TEACHERS

Item	Parents f_t	Teachers $W_t/10$
Parents Bulletins on Health	32	22
Newspaper Ads on Health	25	11
Movie Shorts on Health	9	17
Radio Programs on Health	15	16
Window Exhibits on Health	16	11
Parental Health Questionnaires	36	23

Calculation of X^2 for the above table yielded a value of 9.08 with the probability of as great as or greater result accruing purely through chance being approximately 12 per cent. On this basis we are not justified in attaching a high degree of confidence to the assumption that real differences exist between the opinions of parents and teachers as to the value of the devices.

CONCLUSIONS

The results of the study seem to furnish evidence in support of the following conclusions as answers to questions raised in the statement of the problem.

1. Which of the devices used are most effective in reaching the home with health information?

   (a) Parent questionnaires and parent bulletins were found to be the most effective of the implements studied.

   (b) Radio programs and movie shorts were discovered to be of next relative value.

   (c) Two of the other devices directly considered, namely, newspaper ads and window exhibits, ranked below parent-teacher meetings and newspaper articles.

2. What is the attitude of parents toward the presentation of health information to the home through the various devices?

(a) As revealed by comments, questionnaire returns and interview reactions, the attitude of parents was generally very good.

3. Is there a significant change in the health habits of children following the use of the devices?

(a) In general pupil health behavior displayed significant improvement for several measurable practices.

(b) Apparently the devices acted as a trigger mechanism or catalytic agent in setting off pupil-teacher-parent actions and interactions leading to pupil performance gains.

Recommendations

The writer wishes to make certain recommendations based upon the results of this study.

1. That those charged with the leadership of school health programs make wider use of accessible devices as a measure to assist in harmonizing the influence of the home and school.

2. That the devices be integrated with other phases of the total school health program.

3. That pupils, teachers and parents share in initiating, planning, using and evaluating the devices.

4. That the use of the devices be specifically adapted to the health problems and needs of particular groups of pupils, teachers and parents.

Suggestions for Further Study

The findings here presented must be interpreted in terms of the experimental pattern and measures of pupils, teachers and parents used in this study. Some subsequent studies which would seem valuable in verification and amplification of the findings as reported here are listed below.

1. A study of the effectiveness of the devices in varying types of communities.

2. An analysis of the relative worth of individual devices for matched groups within the same population.

3. An investigation of the value of the devices in relation to the economic status of the home.

4. A study of the effectiveness of the devices in terms of the health behavior for other grade and age levels.

5. An analysis of the influence of the devices on the measurable attitudes of pupils, teachers and parents.

6. An investigation of the worth of the devices as related to divergent educational backgrounds of parents.

READING RETARDATION IN THE SECONDARY SCHOOL*

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Formal instruction in silent reading is usually discontinued by the time the child completes the fifth or sixth grade. It is thought, that, at this stage, pupils will have acquired the fundamental skills in silent and oral reading and will have developed attitudes which will lead them to read extensively. The failure of the typical school program to accomplish these objectives is revealed by the decrease in reading among older elementary school pupils, and by the inadequate skills and needlessly slow reading of many upper elementary and high school students.

Even more noticeable and serious, perhaps, are the reading limitations of an unnecessarily large number of pupils who enter the secondary school. One study shows that 2169 out of 7380 eighth grade graduates read at or below norms for the sixth grade.** For these pupils, as well as for many others displaying less serious reading retardation, instruction in history, science, and the language arts is inappropriate and ineffective.

Teachers of secondary school pupils are often unaware of the nature and the amount of reading retardation in their classes. They assume too frequently that most high school students have developed adequate reading habits and skills. They are sometimes unfamiliar with the range of reading abilities within their own classes and with the severity of the reading handicap in some cases. Consequently, many pupils are offered reading materials of such difficulty that they develop a structure of vague, marginal knowledges in subject areas such as science and social studies. Because of the frequency with which reading limitations are encountered throughout the high school and because of the high relationship between reading ability and success in almost *all* subjects, it is desirable for high school teachers to understand the essential characteristics of the poor reader, the steps in an adequate diagnosis, and some ways in which remedial work may be offered.*

* This paper extends an analysis reported by the writer in *Educational Trends III*, April 1934, pp. 7-13.

** William Kottmeyer. "Improving Reading Instruction in the St. Louis Schools." *Elementary School Journal*, Vol. 45, September 1944. pp. 33-38.

* Paul Witty and David Kopel. *Reading and the Educative Process*. Boston: Ginn and Company, 1939.

AN ANALYSIS OF THE READING STATUS OF 100 NINTH GRADE PUPILS

This paper presents an analysis of 100 ninth grade pupils who were examined in the Psycho-Educational Clinic of Northwestern University. These children were referred to the clinic because their teachers had observed in them repeated indications of poor reading. They show clearly the kind and variety of reading problems with which the secondary school teacher is typically confronted.

The following tests were administered to ascertain the mental and educational levels of these pupils:

Stanford Revision of the Binet-Simon Tests of Intelligence.

One or more performance tests (Porteus, Pintner-Paterson, or Grace Arthur Scales).

Stanford Achievement Reading Test. (Form V.)

Gates Four-Type Tests.

Gray Oral Reading Paragraphs.

Informal tests of reading rate and comprehension.

TEST RESULTS FOR THE GROUP OF 100 POOR READERS

In the group there were 60 boys and 40 girls whose chronological ages ranged from 14 years, 4 months to 16 years, 4 months. The median age both of the boys and of the girls was approximately 15 years. The range in Stanford-Binet I. Q.'s was 77-122; the median, 92. Although these pupils were somewhat retarded in mental ability, most of them appeared able to do satisfactory work in the secondary school if their reading ability were improved. Moreover, at least 20 per cent were above the average in intelligence as measured by the Stanford-Binet tests.

The median grade attainments upon the standardized educational tests are set forth in the following analysis:

Gates Four-Type Tests	*Median Grade*
1. To appreciate the general significance of a paragraph	6.2
2. To predict outcomes	6.1
3. To understand precise directions	6.8
4. To note details	5.2
Stanford Achievement	
Paragraph meaning	6.8
Word meaning	5.9
Gray Oral Reading Paragraphs	6.0

The range of scores on the various tests was from the norm for grade 4 to that for grade 10. Poorest attainments were found in "reading to note details," oral reading, and vocabulary; best work occurred in following fairly specific directions, in which 5 pupils made scores which placed them between the ninth and tenth grade norms. The median rate of silent reading was about 180 words per minute. The rate of oral reading also was noticeably slow, and the frequencies of omissions and insertions of words, as well as of minor and total mispronunciations, were high.

Although the tests analyses yielded some information of importance in understanding the needs of the group, it was thought desirable to supplement these data by a study of contributing factors which were revealed by observation of each child's behavior during the testing and by appraisal of facts in his case history.

Data Related to Poor Reading Obtained through Observation

A tabulation was made of those limitations which were most frequently noted during silent and oral reading of passages from narratives and from factual accounts. Admittedly, this list is the product largely of subjective judgment; and, presented in this form, it may lead to a false impression; namely, that types of errors can be discretely classified. The reader must bear in mind that every poor reader is characterized by several of these symptoms, and that the discovery of the combination of particular needs is the goal of diagnosis. Nevertheless, this analysis does show certain problems with which teachers must cope in planning remedial work. The percentage distribution follows:

	Per Cent
Restricted ability to note detail in various types of reading	64
Slow rate in silent reading	61
Incorrect or inordinate interpretation of total units in silent reading	60
Limited understanding without rereading	60
Inadequate vocabulary	56
Faulty eye movements	40
Slow rate in oral reading	32
Inability to attack new words	32
Somewhat rapid but superficial silent reading	16
Letter or word reading	6

In these 100 poor readers, the following physical conditions were noted:

	Per Cent
Defective vision	14
Generally poor physical condition	12
Left-handedness	4
Defective hearing	3

It might be assumed that correction of physical defects would lead to improvement in reading. For example, the defects in vision could readily have been corrected in most of these cases, but it would be fallacious to infer that this remedy would have provided the cure for the poor reading. Each of these students displayed a particular combination of reading difficulties, and hence required a program of re-education adapted to his specific needs. However, there were certain factors which appeared in many cases. As a group, the pupils gave little attention to details while reading, and they did not comprehend materials as total units of thought. They were inclined to read any assignment whatsoever in a perfunctory manner, with little or no tendency to try to understand it as a whole. Furthermore, they were conspicuously lacking in the capacity to deal with the new vocabulary encountered in other subject fields.

Additional Characteristics of the Group

There were other contributing factors which were revealed through a study of the attitudes of the pupils. The following analysis shows the frequencies of certain characteristics:

	Per Cent
Lack of interest in reading	82
Indifference to reading	44
Dislike for reading	43
Emotional maladjustment	42
Problems of conflict in home	40

The Role of Attitude and Emotional Maladjustment

Lack of interest in, dislike for, or indifference toward reading are indeed conspicuous characteristics of these poor readers. Other defects complicate every case but, almost uniformly, disability cases in the secondary school display one or more of these attitudes. Attention to attitude, therefore, is a significant need. Although attitude is of extreme importance, it

alone cannot be considered *the* cause of reading retardation. For example, one boy expressed a strong aversion to reading; he stated that he had read nothing during the preceding year unless he had been compelled to do so. But this boy had changed schools three times during a single year; his vocabulary (Stanford Achievement Test) was at the 6.9 grade level. Although his intelligence quotient fell in the category designated as "normal," he was flighty in attention, undependable, and seemed almost incapable of organizing and applying the facts he knew. This array illustrates a combination of attitudes and habits which is found in pupils who read poorly.

It is of interest that 42 per cent of the group were emotionally maladjusted. Most of these pupils could be classified as follows: the nervous, excitable child; the slow, indifferent and somewhat recalcitrant pupil; and the timid, withdrawn individual. The exact relationship between poor reading and emotional problems is unknown. However, one investigator, after reviewing the data in thirty studies, concluded that, in all but one case, the emotional maladjustment may have been the result rather than the cause of the reading difficulties.*

Consideration of possible origin of these disturbances makes clear the important role played by failure to succeed. For these pupils, reading had been a discouraging or profitless task which seldom resulted in a complete, satisfying experience. Moreover, the home and the school frequently neglected to offer recognition and praise which all children need. Instead, incompetency and failure were emphasized.

Background of Experience and Related Factors

It is pertinent to observe that meager background of experience and related factors associated with poor homes are frequently found in poor readers. The following characteristics of these 100 poor readers merit attention:

	Per Cent
Meager background of experience	79
Decidedly improverished play life	35
Repeated failure in school	34
Frequent change of school	16

Enrichment of experience and successful achievement are without question basic needs of poor readers. Such pupils must have a series of experiences in reading which are unmistakably successful and individually satisfying.

Materials of proper difficulty are obviously essential in beginning remedial work. However, this provision alone proves insufficient. For these pupils have repeatedly encountered selections that were too long for them to read in the allotted time. Even a good reader, aware of many instances in which he has failed to discover the outcome of a story, or complete an explanation, becomes disheartened. *The retarded reader must be provided with materials short enough that in his allotted time he can experience the satisfaction of completing his assignment.* Accordingly, short stories provide excellent materials for remedial work in the initial stages. If longer treatises are selected for use at this time, they should contain materials which can be divided into short, but complete episodes—ten to twenty pages for ninth grade pupils.

It is admittedly difficult to find books and other materials suited to the interests of ninth grade pupils and at the same time sufficiently simple in sentence structure, vocabulary, and length of unit to elicit success in reading. Nevertheless, there is an increasing amount of material which fulfills these demands.*

Nature of Remedial Programs

Programs for poor readers which have utilized diversified materials of appropriate difficulty have already been described by the writer and others.** The remedial measures undertaken included certain procedures which can readily be adapted for use in secondary schools; and they can be undertaken by any intelligent teacher. The following factors contributed to the success of these programs: complete and thorough diagnosis of the needs of each pupil, group work which required reaction to the content of short episodic accounts, check upon child's reaction to detail, provision of supplementary reading related to individual interests and needs, use of individual progress records, and integration of the remedial work with the endeavor in other classes.

For several reasons, secondary schools might well establish classes for remedial instruction in reading. *First,* there is the opportunity in such

* S. Vincent Wilking. "Personality Maladjustment as a Causative Factor in Reading Disability." *Elementary School Journal,* XLII (December 1941).

* For especially appropriate materials, see: G. M. Blair, "The One Hundred Books Most Enjoyed by Retarded Readers in the Senior High Schools," *English Journal* XXX, January 1941). Ruth Strang and others, *Gateways to Readable Books.* New York: H. W. Wilson, 1944.

** Cf. Paul Witty and David Kopel, *Reading and the Educative Process.* Boston: Ginn and Company, 1939.

classes to treat general group limitations economically. *Second,* individual success in a group having common interests and goals provides a highly satisfying experience for students who have become habituated to failure. *Third,* the possibilities of securing the essential materials and of utilizing appropriate methods of instruction are perhaps greater in classes which operate upon a regular schedule than in individual case work in which the remedial work sometimes is loosely organized and administered.

To bring noticeable gains, it appears necessary to pursue a remedial program daily for at least eighteen weeks with fidelity to a carefully planned schedule of group and individual work. Thereafter, spaced practice and drill are desirable, but a definite program still must be followed for at least one or two additional semesters if gains are to persist. The writer believes that maximum success in remedial reading in most large secondary schools will result from the initiation of special classes for remedial endeavor. These classes should, however, be looked upon as a temporary means of meeting a serious problem. The desirability of such classes is suggested by the records of the one hundred disability cases which were examined in the Psycho-Educational Clinic of Northwestern University and described in this article. About half of these pupils were placed in special classes and individual work was suggested for the others. During the following two years, the children were again examined. Only about one-fifth of the pupils who were not enrolled in special classes made significant gains in reading. Some individual remedial work was undertaken, but it was carried on for a short period of time only. Interest lagged; conflicting duties interrupted the regularity of the effort; and, little by little, the pupils and teachers abandoned the enterprise. This situation is very different from that found in the remedial classes organized for the other half of these pupils. In the special classes, almost all pupils made significant, steady progress.*

Concluding Note

The amount, nature, and severity of poor reading in the secondary school necessitates the establishment of special classes. The impetus given to learning through membership in a participating group and the gains resulting from strict adherence to an expertly directed program make possible the rehabilitation of large numbers of retarded secondary school students. Not the least important among the concomitants of such work is the stimulating effect it has in extending and enriching out-of-school experiences—a condition which seems to contribute greatly to the mental hygiene and personality adjustment of the pupils. However, special classes should be looked upon as temporary expedients.

It should be recognized that the provision of remedial programs alone is inadequate to meet the needs of the modern high school. Such efforts should be associated with a broader concern aiming to lessen inequalities and to offer every boy and girl the educational opportunities essential for his full development. The great needs at present seem to be: remedial work for some and developmental reading programs for all pupils.

* Cf. Paul Witty and Lou LaBrant. "Some Results of Remedial Instruction in Reading." *Educational Trends.* Volume I, 1933. Paul Witty and David Kopel, *Op. Cit.,* Chapter 5.

AN EXPERIMENTAL EFFORT TO CHANGE THE ACHIEVEMENT TEST PROFILE

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INTRODUCTION

F. S. Freeman included a chapter on Special Abilities and Disabilities in his textbook on Individual Differences. He concluded that chapter as follows:

> . . . one cannot but be impressed by the small beginnings or initial handicaps from which serious disabilities may develop in the course of time. Similarly, one is impressed by the relatively small initial differences which, when combined with continued zeal and competent instruction, may eventuate in very large final differences such as to constitute, in effect, special abilities.

That was thirteen years ago. Today, in the light of intervening experience in remedial education, there is a great deal more factual data to be impressed by. I am impressed as Freeman was. In imagination I have no difficulty in seeing the picture. Take for instance a bright boy in the third grade. Let us say that he is doing equally good work in all areas. But suppose on a certain day the third grade in question has a visitor. The work at the moment happens to be in arithmetic. The bright boy is complimented for his work. (He would have been complimented for his work no matter what the area, but it happened to have been in arithmetic.) He is pleased at the attention and for some time after this he re-lives his pleasure as he participates in and looks forward to the work in arithmetic. The teacher notices how the boy's work impressed the visitor. Because of this fact, her attention is directed more than it had been to the pupil's work in arithmetic. She notices that the boy "likes arithmetic" and realizes that he "is good in arithmetic." The boy's parents hear about it. They are pleased. More reason for liking arithmetic. Arithmetic is favored over other areas of work in effort and time. But this is only the third grade. Imagine what could be added to this beginning in the fourth, fifth and sixth grades, in the junior high school, the senior high school, and in college. Before high school, the so-called "special ability" could be pronounced. In high school and college, electives could be chosen or rejected on the basis of it, other areas neglected, and poor results rationalized in terms of supposed native predispositions.

Now all this sounds very plausible, if you are in the habit of attributing patterns of ability to such environmental origins. But, if that is not your habit, you are not impressed. And there are many students and parents and teachers and counselors who are not the least bit impressed. They say, "Of course, the mature pattern develops from small beginnings, but nature supplies those small but very important beginnings." They read a statement like Freeman's and they are quick to notice that he does not point to environmental origins so much as he points to the smallness of the "initial handicaps" or the "initial differences" from which the mature pattern develops.

It has been over twenty years since Watson rejected a fatalistic interpretation of ability patterns and made his famous offer to develop any patterns of specialized abilities for any dozen healthy infants. Yet to what experimentation would you point as a specific effort to test his hypothesis? If educational profiles are as environmentally determined as I think they are, patterning can be planned and controlled but data are needed. For instance, suppose that parents went to their son's teacher and asked, "Will you try to direct our son's education so that he develops a special ability in arithmetic?" Could the teacher do it if she tried? How sensitive is the educational profile to such effort? The remainder of this paper is a report of an experiment prompted by these questions,

THE EXPERIMENT

The experiment was conducted in three schools under one supervisor. The very cordial cooperation of the supervisor was the basis for the choice. The supervisor's help was available throughout the experiment, and largely because of it good cooperation was received from the teachers involved. The Unit Scales of Attainment, Division 1, Forms A and B were administered to all pupils beginning the fourth

TABLE I

THE RESULTS OF MATCHING

			Experimental Group	Control Group
	Number of Boys		16	16
	Number of Girls		21	21
	Total		37	37
Ar. Age	Av.		114.1	114.4
	S. D.		6.5	7.2
E. Age	Av.		115.9	116.2
	S. D.		8.6	8.1
C. Age	Av.		112.9	113.0
	S. D.		6.3	6.4
Problems	Av.	Form A	115.5	116.9
	Av.	Form P	114.0	114.4
Computation	Av.	Form A	115.5	114.3
	Av.	Form B	111.3	112.0
E. A.	Av.	Form A	115.9	116.5
	Av.	Form B	115.9	115.9
Teacher A	Av.	Ar. A	112	112
	Av.	E. A.	115	116
	Av.	C. A.	113	111
Teacher B	Av.	Ar. A	122	121
	Av.	E. A.	123	123
	Av.	C. A.	109	109
Teacher C	Av.	Ar. A	111	111
	Av.	E. A.	118	118
	Av.	C. A.	112	112
Teacher D	Av.	Ar. A	107	107
	Av.	E. A.	112	112
	Av.	C. A.	116	113
Teacher E	Av.	Ar. A	116	117
	Av.	E. A.	113	112
	Av.	C. A.	117	117
Teacher F	Av.	Ar. A	112	113
	Av.	E. A.	110	113
	Av.	C. A.	112	115

grade. Forty-five pupils were selected as the experimental pupils in the six fourth grades. The basis for selection was to take all pairs which could be satisfactorily matched for chronological age, educational age, and arithmetic age. The only exclusions were pupils for whom arithmetic was already a pronounced peak in the profile.

This concern about arithmetic was due to a decision to confine the experimental effort to one phase of the profile, namely, the place of arithmetic in it. In view of the defined purpose, the experimental and control pupils needed (1) to be at the same general level of progress, (2) to be at the same level of progress in arithmetic, (3) not to have the arithmetic level so far above the general level as to make it unreasonable to expect an increase in the differential, and (4) to have had the same previous rate of development.

The results of the matching for the thirty-seven pairs finally used (eight cases were lost in the course of the two years) are reported in Table I. The second section of the table shows the matching in terms of Forms A and B separately, and for the parts of the arithmetic

test, namely, problems and computation. The section at the bottom of the page shows that the matching was close, since it made even the little groups in each grade fairly comparable. One pupil of each pair was arbitrarily called an experimental pupil and the other a control. The names of the experimental pupils were given to the teachers with these instructions:

PURPOSE OF THE INVESTIGATION

Some pupils are equally good or equally poor in all their subjects. Others are better in one subject than in the others or poorer in one than in the others. It is the purpose of this investigation to try to find out to what extent arithmetic could be made a child's best subject as a result of special attention and help from the teacher.

YOUR PART IN THE INVESTIGATION

In order to find this out, I am asking you to give special attention and help to the pupils whose names I have given you. Use the notebooks, which I am providing, to keep a record for me of the date, occasion, amount, and kind of help, encouragement, reward, or praise which you give to each of the children listed. I am asking you to treat each of these pupils as if you thought he or she needed help and encouragement in arithmetic. In other words, try to act as if really interested in their advancement in arithmetic. A perfunctory compliance with my request would not be effective, I am sure.

I don't want this to be a burden on your time. I think you can soon get the habit of helping and encouraging these pupils here and there in the course of the regular work.

The names of the experimental pupils and these same instructions were given the following fall to the fifth grade teachers. In two of the six cases it was the same teacher who had been moved on with the grade. At the end of the second year, that is, at the end of the fifth grade, the Unit Scales of Attainment, Division 2, Forms A and B were administered, not just to the experimental and control groups, but to all fifth grade pupils. Division 1, designed for grades three and four, was well suited for grade four at the beginning of the year, and Division 2, designed for grades five and six, was well suited for grade five at the end of the year.

THE RESULTS

The results of the experiment are in Table II. Your attention is called first to the title of the table and to the supplementary note at the bottom of the table. Four things need to be noted. First, the units, as in Table I for matching data, are months. All scores were given age equivalents from tables of norms, and these age equivalents were used throughout. The second thing to remember in looking at the results is that they pertain to the place of arithmetic in the profile; that is, to the plus or minus deviations of arithmetic ages from educational ages, not to arithmetic ages by themselves. In the third place, since this was an experimental effort to change the place of arithmetic in the profile, changes are involved. These changes, positive or negative, are the differences between arithmetic age minus educational age before and after the two year period. Fourth, and finally, since this was a controlled experiment, what is wanted is how experimental group changes differed from control group changes. The data in Table II summarizes all of these comparisons.

Looking now at the bottom of the table, you will see two averages for the whole group, +.48 of a month per pupil or +.02 of a month per teacher-team. These averages are measures of the effectiveness of the experimental effort. The +.48 means that, on the average for the thirty-seven pupils, the experimental effort caused arithmetic to be more of a peak, or less a trough, as the case may be, by an amount which is equivalent to two weeks of normal school progress. That is, it would mean that if it were not a statistically insignificant result. As it is, it cannot be concluded on the basis of these general averages that the experimental effort had any effect.

But the general averages do not tell the whole story. They are not equally good descriptions of the results for the six teacher-teams. Under the B team, the average effect was +6.9 or approximately 7 months. This is a substantial influence in the direction of a special ability in arithmetic and the average passes the 1% test. The next most statistically significant result is for the six pupils under the F teacher-team. This average passes the 5%, though not the 1% test. It is a surprising result

TABLE II

EXPERIMENTAL MINUS CONTROL
Average Changes in Arithmetic Profile Scores*
(The Unit is One Month)

School	Teacher-team	No. of pairs of pupils	Problems		Computation		Forms A & B averaged		Probs. & Comp. averaged		All 4 measures	Degrees of freedom used	Chances of being a sampling variation from zero
			Form A	Form B	Form A	Form B	Probs.	Comp.	Form A	Form B			
I	A	8	3.5	2.0	2.4	10.0	2.8	6.2	2.9	6.0	4.5	7	P>5
II	B	7	8.9	.9	5.7	12.0	4.9	8.9	7.3	6.4	6.9	6	P< 1
	C	6	—6.8	—8.3	—8.3	0.0	—7.6	—4.2	—7.6	—4.2	—5.9	5	P>5
III	D	3	3.3	0.0	—6.3	3.6	1.7	—1.3	—1.5	1.8	.2	2	P>5
	E	7	—2.3	4.1	.1	6.6	.9	3.4	—1.1	5.4	2.1	6	P>5
	F	6	—8.0	—7.5	—6.3	—9.0	—7.8	—7.7	—7.2	—8.3	—7.7	5	<P<5
3	6	37					Average per pupil				+ .48	36	P>5
							" " teacher-team				+ .02	5	P>5

*Arithmetic profile score is used here to refer to arithmetic age minus educational age. It is a measure of the extent to which a pupil's arithmetic score is above or below the pupil's average score.

in that it is negative. The teacher (it was one teacher, not two, because F was one of the fourth grade teachers moved on with her pupils) tried to create a special ability in arithmetic and she succeeded in developing a relative disability. The averages for the other four groups do not pass the 5% test. The nearest to it is a +4.5 for those under the A teacher-team, and a −5.9 for those under the C teacher-team. The chances that these results are sampling variations from zero were well below 50%, as might be inferred from the four independent measures obtained, and reported in the first four columns of findings under Problems, Form A, and Form B, and Computation, Form A, and Form B. In brief, for the thirty-seven pupils, or for the six teacher-teams, (whichever way you want to look at it) the average result was practically zero, not because the result was in each case near zero, but because diverse influences were practically balanced. The C and F teams were about as effective in the wrong direction as the other teachers were in the direction attempted.

A negative outcome was not anticipated. It was thought that the question was simply whether or not the result would be significantly above zero. And probably you are asking, as the writer did, "Are you sure the result is reliable and attributable to the experimental effort?" The remainder of the paper is devoted to a consideration of this question, first to reliability, and second as to experimental validity.

Reliability

Little need be said concerning the use of small sample statistics in this case. This use involved a more, rather than less, rigorous test of significance. Had N's and large sample probability tables been used, the B and F means would have been reported as respectively 4.5 and 3.4 times their standard errors. It may be seen in the last column in Table II that no inappropriately large number of degrees of freedom were used. I mention this because the over-eager researcher is sometimes led into such an error when he is pooling several independent measures, as was done in this case.

This pooling made its contribution to reliability nonetheless. The reliability coefficient for the final measures reported is .69, and this in spite of the fact mentioned in presenting Table II that the measures are differences between paired pupils in changes in profile scores which are themselves differences. The standard error of a measure is six months. Tested by this error at the 5% level of significance, five profiles were reliably changed as requested, five were reliably changed in a direction opposite to the teachers' efforts. Four of the former were taught by the A and B teacher-teams, four of the latter by the C and F teams. As a result of teacher D's effort (this was the other fourth grade teacher who was moved on with her pupils), arithmetic was reliably raised for one of her pupils and reliably lowered for another. This fact should be kept in mind in any attempt at explanation and will be referred to later in that connection. Here it is mentioned with the preceding statements for its bearing on reliability. When data permit the reliable observation of individual experimental outcomes in the profiles of ten of the thirty-seven pupils, it is not surprising that they should be reliable enough for small group comparisons.

Validity

There remains then the question of experimental validity. Is it reasonable that an effort to raise arithmetic in the profile could lower it? The answer is yes, for two reasons. First, we are talking about changes of the place of arithmetic in the profile. The negative findings reported do not mean that pupils were less able in arithmetic than before. They mean that, because of the experimental attention and effort, arithmetic progress did not keep pace with general progress as closely as it otherwise would have done. Large gains took place during the experiment. On the average, educational ages were twenty-two months higher at the end of the experiment. Profiles can change shape a great deal during such a period of development. Furthermore, it is easy to think of a pupil's making relatively less progress in arithmetic than in other areas under constant teacher prodding for better work in arithmetic.

The results are understandable, on this basis, not only as a generalization, but on the basis of the procedures actually reported by the teachers involved. On the basis of these notebook records, the B teacher-team was picked as the one most likely to have raised arithmetic in the profile. The way they went about helping and encouraging the experimental pupils, and the reactions of these pupils as reported, suggested that individualized education was not a novelty in this room. There was some evidence of interest and skill in diagnosis on the part of

these teachers. Both help and praise were given generously, yet one got the impression that neither was overdone. F's record, on the contrary, appeared to be the least promising. The experimental pupils were formed into a small group. The chief recourse of this teacher seems to have been to send notes home to the parents, mostly by way of complaint; and this in spite of the fact, by her own record, that it didn't seem to do any good. In order to give some objectivity to the opinions just expressed, two good judges of elementary school teaching were asked to read these records and to pick the teacher-teams most and least likely to have raised arithmetic in the profile. Each judge picked the B and F teams.

Since the D teacher's efforts had demonstrably different effects on two of her pupils, you may care to know something of her records. They are the most wordy. They give the impression that she talks to her pupils a great deal and in a breezy manner. Praise is in superlatives, and the whole class is asked to notice. There is some tendency to employ ridicule in the same way, and there is a considerable amount of appeal to inter-pupil competition. Here the expectation was for poor results, and the wonder is that because of her efforts, for one of her pupils, the place of arithmetic in the profile was improved. But, after all, one pupil can thrive and another retreat under the same treatment. There is then, even here, no reason to question the experimental validity of the findings reported; and a brief summarizing statement is in order.

Summary

The names of thirty-seven pupils in six fourth grades (approximately one of each six enrolled) were given to the teachers with the request that the teachers try to raise the place of arithmetic in the achievement test profile. As a result of this request, the place of arithmetic in the profile was changed by a statistically and educationally significant amount for ten of the thirty-seven pupils, and on the average for those in two of the six rooms. These results give some support to the pupil, parent, teacher, or counselor who says of an academic profile, "It may be of environmental origin." However, this is not equivalent to saying that the shaping of profiles is at present well within our control. If the group of teachers who cooperated in this experiment and other related factors are representative, a request for a specific kind of pattern of ability is as likely to have contrary outcomes as it is to have positive results, the net control exercised being, in a sense, nil.

The writer is of the opinion that the differences in effect from room to room were primarily due to the differences in teacher personality and procedure, but this may not be stated as a conclusion from the experiment. There were other variables from room to room as Table I shows.

This concludes the report so far as the purpose of the experiment is concerned, but it is pointed out, in conclusion, that the results may have implications for remedial education. Although the experimental situation was not designed to parallel the organization of remedial education, there is enough resemblance to suggest that perhaps remedial education also varies in effectiveness from positive to negative. In other words, it is conceivable that poor remedial effort may do more harm than good.

THE VALUE OF CAUSE AND EFFECT ANALYSIS IN DEVELOPING ABILITY TO RECOGNIZE CAUSE AND EFFECT RELATIONSHIPS*

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THE PROBLEM

The aim of this investigation was to compare two teaching procedures in ninth-year general science with reference to their effectiveness in producing growth in the ability to recognize three accepted degrees of cause and effect relationship (direct, indirect, and negative). One teaching procedure was the regular text-laboratory instruction; the other was, in addition, specific training in the analysis of cause and effect relationships.

In this study the terms used were defined as follows:

1. Ability to recognize the degree of cause and effect relationship is the skill to classify or identify the relationship between two complete physical events.

2. A cause and effect relationship exists between two specific events, if the first always, except for errors of observation, is followed by the second in the same order of sequence.

3. Direct causality exists when no known event intervenes between a cause and its effect. Indirect causality prevails when one or more connected events intervene between a cause and its effect. Negative causality is the absence of direct and indirect causality.

The specific questions that the study sought to answer were:

1. Is the proposed teaching procedure (of cause and effect analysis) more effective in developing ability to recognize the three different degrees of cause and effect relationship than the procedure currently employed:

   (a) For the entire group (experimental and control)
   (b) For either sex
   (c) For any one of three intelligence levels

2. Is the ability to recognize one of the three degrees of cause and effect relationship developed to a greater extent than the others by the proposed procedure:

   (a) For the entire group
   (b) For either sex
   (c) For any one of three intelligence levels

METHOD OF PROCEDURE

The plan that was followed in this research consisted of three main steps:

1. The administration of an initial test in the ability to recognize the three degrees of cause and effect relationship

2. The application of the experimental and control teaching procedures

3. The administration of a final test in recognizing causal relationships

The initial test was administered at the beginning of the February term, 1941, by the regularly assigned teachers of the 17 classes involved.** For the next sixteen weeks, the experimental group was given instruction which included the analysis of observed physical phenomena into their component causal relationships. This was done by having three columns, labeled Effect, Cause, Evidence, written on the blackboard after each demonstration had been completed and recorded in the pupils' notebooks. A pivotal observation was then selected by the teacher and its statement was written in the "Effect" column. The pupils were then requested to find, by cogent reasoning, the cause or causes of the observed effect. When an acceptable response was made, it was written in the "Cause" column. In the "Evidence" column was written the reasoning by which the answer to the previous column was arrived at. Only after all three columns were filled in at the blackboard were the pupils permitted to copy them into their notebooks. The final test in the ability under investigation was given at the end of the first school week in June 1941.

The experimental and control classes were selected at the start of the investigation by each

* Abstract of thesis for Ph.D. degree, New York University, 1942.

** Six different teachers in four high schools cooperated in the instructional phase of the study.

cooperating teacher, according to mimeographed instructions. Teaching conditions were kept constant for all classes in that the same teachers, the same syllabus units, and the same demonstrations were used for all. The matching of individual pairs of equated pupils was done on the basis of two measures of learning potential; namely, the initial test score and the intelligence quotient. These were converted into a single value by means of a scatter diagram. In this manner a total of 169 matched pairs of pupils were obtained. The critical ratio of the difference between the experimental and the control groups was .114. Supervision of the instruction by the investigator was done by means of:

1. Classroom visits and individual teacher conferences
2. Mimeographed materials supplied to the six teachers describing
   (a) The study as a whole
   (b) The procedure for administering the tests
   (c) Cause and effect analyses for the units of the entire syllabus

Four syllabus units of instruction were employed as the learning materials of this investigation. These dealt, respectively, with the importance of air, water, sun energy, and food for the maintenance of living things.

The items of the test to measure the ability to recognize three different levels of causal relationship were based on the topics and subtopics of the above units. Each test item consisted of a description of a pair of physical events. The sentences describing these events were separated from each other by a // typographic mark. For example, "A cow eats grass. // The cow gives milk." The pupils were required to state whether the condition described in the first sentence of the above pair was a direct cause, indirect cause, or no cause of the second by encircling one of the letters *D, I,* or N, written at the left of the number of each question. The initial test contained 60 items. The final test contained 78 (the initial test plus 18 additional items). The reliability indices of the initial and final tests were .88 and .91, respectively. Each item was selected only if:

1. Seventy-five per cent of a jury of at least six experts agreed upon its syllabus validity, clarity of language, and its answer.
2. It had an internal validity index of above .20.
3. Its difficulty index was between .10 and .90.

The tests were administered in 35 minutes, as group examinations.

The Evidence

The increments of the final test scores over the initial test scores were calculated for each pupil of the experimental and the control groups. The average scores and sigma scores of these increments were used in comparing the relative effectiveness of the teaching procedures with each main group, each intelligence level, and each sex. A summary of the statistical findings of this investigation, stated in sigma scores, follows. (Not all of these findings are statistically reliable but they are included in order to present a complete summary.)

1. The experimental group exceeded the gains of the control:
   (a) For the groups as a whole, by 1.35 sigmas
   (b) For the lower, middle, and upper intelligence levels by 1.01, .91, and .13 sigmas, respectively
   (c) For boys by 1.91 sigmas and for girls by .05 sigmas

2. The gains in the ability to recognize each of the three degrees of cause and effect relationship were determined for the groups as a whole, for the three intelligence levels, and for both sexes. These results are summarized in Table I (page 212).

The correlation between the intelligence quotients and the measurable growth in the ability investigated was $.11 \pm .06$ for the experimental group and $.17 \pm .07$ for the control group. Both of these r's were shown to be unreliable.

Conclusions

On the basis of the findings presented above it seemed defensible to draw the following conclusions:

1. The proposed procedure of systematic analysis, by the pupils, of causal relationships in the physical phenomena observed in the classroom demonstrations in ninth-year general science, results in a slightly greater growth in their ability to recognize cause and effect relationships of the indirect degree than is obtained by the currently employed procedures

TABLE I

THE SIGMA SCORE GAINS MADE BY THE DIFFERENT GROUPS IN RECOGNIZING EACH OF THE THREE DEGREES OF CAUSE AND EFFECT RELATIONSHIP

Group	Degree of Causality	Sigma Score of Difference in Mean Gain		Probability of Difference Recurring in 10,000
		Exp.	Con.	
Experimental and Control	Direct		.284	6114
	Indirect	1.749		9599
	Negative	.835		7981
Intelligence				
	Direct		.676	7506
Upper Level	Indirect	.840		7994
	Negative	.112		5448
	Direct	.576		7176
Middle Level	Indirect	.559		7118
	Negative	.598		7249
	Direct		.318	6247
Lower Level	Indirect	.940		8264
	Negative	.951		8293
Sexes				
	Direct		.079	5319
Boys	Indirect	1.532		9373
	Negative	1.648		9503
	Direct		.439	6700
Girls	Indirect	.957		8307
	Negative		.188	5744
		Boys	Girls	
	Direct		.587	7214
Experimental	Indirect	1.408		9204
	Negative	2.393		9916
	Direct		.985	8377
Control	Indirect	.671		7489
	Negative	.385		6498

where causal relationships are taught concomitantly and/or passively.

2. The fact that pupils of both groups made scores on the initial test that were substantially above zero on causal relationships which they had never been taught before indicates that the ability to recognize the three degrees of cause and effect relationship exists to a certain extent in ninth-year pupils by virtue of their previous school and home experiences.

3. The fact that all the classes of the control group made slight gains in the ability to recognize causal relationships indicates that this ability is to some extent a concomitant outcome of the study of general science under the conditions met in this experiment.

4. The fact that a low coefficient of correlation exists between intelligence and growth in the ability to recognize the three degrees of causality indicates that this skill is probably a discrete one and is not identical with intelligence. It may not be assumed that intelligent pupils will always surpass duller ones in this ability.

5. From the obtained data it seems reasonable to assume that the proposed teaching procedure will probably be relatively more effective with the pupils of the lower third of intelligence than with those of the upper third.

6. No consistent relationship was found between age and growth in ability to recognize cause and effect relationships. It may not be assumed that ability to recognize the three degrees of causal relationship in science situations develops in high-school pupils solely as the result of maturity. The number of experiences involving causal relationships, whether in school or outside, probably determines the extent of growth in this ability.

RECOMMENDATIONS

The proposed procedure of cause and effect analysis is recommended for use in ninth-year general science classes because it appears

TABLE I

THE CRITICAL RATIOS OF THE CLOSENESS OF MATCHING OF EXPERIMENTAL AND CONTROL CLASSES ON THE BASIS OF INITIAL CRITERIA TEST SCORES

Exp.-Con. Pairs	No. of Pupils Per Class	Difference in Means	Standard Error	Critical Ratio
a	21	.048	.175	.274
b	22	.045	.069	.652
c	27	.037	.221	.167
d	12	.083	.378	.219
e	16	.000	.204	.000
f	14	.286	.245	1.167
g	18	.500	.232	2.155
h	8	.125	.239	.523
i	17	.470	.229	2.052
j	14	.000	.392	.000
Total 10	169	...	...	...

to have several potential advantages and because it is consistent with the accepted objectives of science education.

1. It meets the pupils' needs for living in a democratic, technological society, to the extent that the skill to reason causally is automatically transferred to meeting the need to interpret correctly the conflicting political and social propagandas, on one hand, and specious advertisements, on the other.

2. It is a problem-solving approach to science teaching, not a stilted, dry-as-dust drill scheme or a mnemonic device. Teachers who have used it reported it to be a stimulant to thinking and a catalyst toward discussion.

3. It is believed to be influential in developing the scientific attitude of belief in cause and effect explanations for happenings since it is predicated upon suspended judgment and testing of hypotheses.

4. It is particularly recommended that the proposed procedure be used with pupils of the lower third of intelligence since it effected a greater gain in their ability to recognize the indirect and negative degrees of causal relationship than in that of the pupils of the other two intelligence levels.

5. It is suggested that, by means of the proposed procedure, girls, especially, be given instruction and practice in discriminating between the varying degrees of causal relationship.

It is suggested that the following corollary researches be made:

1. The accepted scientific attitudes should be analyzed into the tendencies, urges, and behaviors of which experts consider them to be constituted. Each such pupil behavior or activity should then be taught by a specific procedure. An evaluation of the procedure, in a manner

TABLE VII

THE CHANGE IN THE MEAN SCORES AND STANDARD DEVIATIONS OF THE GAINS MADE BY THE PUPILS OF THE THREE INTELLIGENCE-LEVELS OF THE EXPERIMENTAL AND CONTROL GROUPS*

	Lower Level I.Q. 76-98			Middle Level I.Q. 99-108			Upper Level I.Q. 109-153		
	Mean Gain	S.D.	Cases	Mean Gain	S.D.	Cases	Mean Gain	S.D.	Cases
Experimental Group	17.000	7.613	45	19.064	7.634	47	19.273	5.280	44
Control Group	15.519	6.761	52	17.700	6.506	64	19.113	6.789	53
Difference	1.481	.852		1.364	1.364		.160	—1.509	

* The actual number of pupils in the control group was 169 and in the experimental group 136. However, in three instances, pupils of one experimental class were paired with those of two control classes in two separate operations, thus yielding two pairs of matched classes instead of one.

TABLE VIII

THE SIGNIFICANCE OF THE GAINS IN FAVOR OF THE EXPERIMENTAL GROUP PUPILS IN THE THREE INTELLIGENCE LEVELS

Intelligence Level	Difference in Gains	S.E. of Difference in Means	Critical Ratio	Probability of Recurrence of Gain in 10,000 Cases
Lower	1.481	1.472	1.006	8413
Middle	1.361	1.379	.907	8178
Upper	.160	1.226	.131	5521

TABLE IX

A COMPARISON OF THE AVERAGE GAIN MADE BETWEEN THE INITIAL AND FINAL TESTS BY THE SAME SEX OF EACH GROUP

Group	Average Gain		No. of Cases		S.D.	
	Boys	Girls	Boys	Girls	Boys	Girls
Experimental	68	91	19.588	17.604	6.789	6.726
Control	91	78	17.462	17.359	7.167	6.302
Difference	23	13	2.126	.245	.378	.424

TABLE X

THE GAINS MADE BY DIFFERENT GROUPS IN RECOGNIZING EACH OF THE THREE DEGREES OF CAUSE AND EFFECT RELATIONSHIP

Group	Degree of Causality	No. of Cases		Total Gain		Mean Gain		Mean Advantage	
		Exp.	Con.	Exp.	Con.	Exp.	Con.		Control
Exper. and Control	Direct	169	169	971	988	5.746	5.846		.100
	Indirect	169	169	1133	1000	6.704	5.917	.787	
	Negative	169	169	1008	955	5.964	5.651	.313	
Intelligence Upper Level	Direct	44	53	262	344	5.954	6.491		.537
	Indirect	44	53	315	347	7.159	6.547	.612	
	Negative	44	53	271	322	6.159	6.075	.084	
Middle Level	Direct	47	64	276	348	5.872	5.438	.434	
	Indirect	47	64	321	407	6.830	6.359	.471	
	Negative	47	64	299	378	6.362	5.906	.456	
									.258
Lower Level	Direct	45	52	248	300	5.511	5.769		
	Indirect	45	52	264	251	5.867	4.826	1.041	
	Negative	45	52	253	256	5.622	4.923	.699	
Sexes Boys	Direct	68	91	376	507	5.529	5.571		.042
	Indirect	68	91	498	558	7.324	6.132	1.192	
	Negative	68	91	458	524	6.735	5.758	.977	
Girls	Direct	91	68	537	481	5.901	6.166		.265
	Indirect	91	68	572	442	6.286	5.666	.620	
	Negative	91	68	493	431	5.421	5.526		.105

TABLE XI

THE STATISTICAL SIGNIFICANCE OF THE GAINS MADE BY THE DIFFERENT GROUPS IN RECOGNIZING EACH OF THE THREE DEGREES OF CAUSE AND EFFECT RELATIONSHIP

Group	Degree of Causality	Difference in Mean Gain		S.D. of Mean Gain		S.E. of Mean Gain		S.E. of Difference in Mean Gain	Sigma Score of Difference in Mean Gain		Probability of Difference Recurring in 10,000 Cases
		Exp.	Con.	Exp.	Con.	Exp.	Con.		Exp.	Con.	
Exper. and Control	Direct		.100	3.255	3.229	.250	.248	.352		.284	6114
	Indirect	.787		4.117	4.211	.312	.324	.450	1.749		9599
	Negative	.313		3.314	3.571	.255	.275	.375	.835		7981
Intelligence											
Upper Level	Direct		.537	3.760	4.047	.567	.556	.794		.676	7506
	Indirect	.612		3.309	3.868	.499	.531	.729	.840		7994
	Negative	.084		3.470	3.889	.523	.534	.747	.112		5448
Middle Level	Direct	.434		4.195	3.524	.612	.440	.754	.576		7176
	Indirect	.471		4.619	4.054	.674	.507	.843	.559		7118
	Negative	.456		3.800	4.192	.554	.524	.763	.598		7249
Lower Level	Direct		.258	4.102	3.806	.612	.528	.808		.318	6247
	Indirect	1.041		5.286	5.607	.788	.778	1.107	.940		8264
	Negative	.699		3.536	3.694	.527	.512	.735	.951		8293
Sexes											
Boys	Direct		.042	3.763	3.945	.456	.414	.529		.079	5319
	Indirect	1.192		5.074	4.541	.615	.476	.778	1.532		9373
	Negative	.977		3.133	4.336	.380	.455	.593	1.648		9503
Girls	Direct		.265	4.193	3.642	.440	.412	.603		.439	6700
	Indirect	.620		3.869	4.463	.406	.505	.648	.957		8307
	Negative		.105	3.777	3.496	.396	.396	.560		.188	5744
		Boys	Girls	Boys	Girls	Boys	Girls		Boys	Girls	
Exper.	Direct		.372	3.763	4.193	.456	.440	.634		.587	7214
	Indirect	1.038		5.074	3.869	.615	.406	.737	1.408		9204
	Negative	1.314		3.133	3.777	.380	.396	.549	2.393		9916
Control	Direct		.575	3.945	3.642	.414	.412	.584		.985	8377
	Indirect	.466		4.541	4.463	.476	.505	.694	.671		7489
	Negative	.232		4.336	4.496	.455	.396	.603	.385		6498

TABLE XIII

POINT GAINS MADE BETWEEN THE INITIAL AND FINAL SCORES BY EACH PAIR OF MATCHED CLASSES

	Experimental Group				Control Group			
Class	Total Gain	Dir.	Indir.	Neg.	Total Gain	Dir.	0001	Neg.
a	345	111	133	101	344	130	98	116
b	427	121	167	139	388	156	911	108
c	502	120	204	178	448	132	0ϕ	153
d	259	85	89	85	254	80	121	88
e	257	69	101	87	227	105	601	65
f	273	79	97	97	245	68	45	68
g	363	102	134	127	353	88	98	144
h	141	72	27	42	139	40	591	59
i	283	107	97	79	276	88	124	72
j	262	105	84	73	269	101	86	82
Sums	3112	971	1133	1008	2943	988	Indir.	955

similar to that used in this study, could then be made. A program of such studies might supply much needed data toward a scientific solution of the problem of educating for the scientific attitudes(s).

2. This investigation should be extended to elementary schools and colleges in order to find how effective the proposed teaching procedure is at other learning levels.

3. A research similar to this one should be made in the teaching of the other specialized sciences of chemistry, physics, biology, and earth science.

4. The correlation between the ability to recognize the three degrees of cause and effect relationship and (1) reading ability, (2) science information, and (3) socioeconomic status should be studied.

5. A comparison should be made of the ability to recognize the degrees of causal relationship in science with those of everyday life.

6. Other techniques of evaluating ability to recognize the degrees of cause and effect relationships should be evolved and refined.

7. Abilities related to cause and effect relationships other than that of recognition should be studied. Suggested abilities are:

(a) The selection of causally related pairs of events from an assorted group of situations and the identification of the degree of relationship between them

(b) The application of cause and effect relationships to the solution of problems on the "how" and "why" of physical phenomena

(c) The formulation of causal relationships (and their degree of causality) between physical conditions or phenomena from given sets of data

8. A research, spread over several semesters, should be conducted in order to determine to what extent the change brought about in individual pupils by the proposed teaching technique is a permanent one.

ON A CLASS OF INTERPOLATION FUNCTIONS

FOR

SYSTEM OF GRADING

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I. Introduction. Systems of grading fall into the three following general classes:

1. The percentage system.
2. The up-step percentage - point systems.
3. The down-step percentage - index systems.

The system, class (1), in which grades are given in final form, varying continuously from 0% to 100%, is a uniform, linear distribution system and presents neither serious interpolation problems nor transformation difficulties.

The systems, class (2), are such that, to successive percentage intervals, from 0% to 100%, are assigned, respectively, increasing point values. The following are examples in class (2):

(a)
A - Excellent - - - - 90% to 100% - 3 Credit-Points
B - Good - - - 80% to 90% - 2 Credit-Points
C - Fair - - - 70% to 80% - 1 Credit-Point
D - Poor (but passing) - - 60% to 70% - 0 Credit-Points
E - Failure - - - - 50% to 60% - (-1) Credit-Point
F - Failure - - - - 0% to 50% - (-2) Credit-Points

(b)
A - Excellent - - - - 90% to 100% - 4 Credit-Points
B - Good - - - - 80% to 90% - 3 Credit-Points
C - Fair - - - - 70% to 80% - 2 Credit-Points
D - Poor (but passing) - - 60% to 70% - 1 Credit-Point
F - Failure - - - - 0% to 60% - 0 Credit-Points

(c)
A - Excellent - - - - 95% to 100% - 3 Credit-Points
B - Good - - - - 85% to 95% - 2 Credit-Points
C - Fair - - - - 75% to 85% - 1 Credit-Point
D - Poor (but passing) - - 65% to 75% - 0 Credit-Points
F - Failure - - - - 0% to 65% - 0 Credit-Points

(d)
A - Excellent - - - - 85% to 100% - 2 Credit-Points
B - Good - - - - 70% to 85% - 1 Credit-Point
F - Failure - - - - 0% to 70% - 0 Credit-Points

These and all other examples of class (2) when mathematically interpreted result in step-functions[1] constant in stretches, with uniform up-jumps at the close of the stretches all of which, after the first, are uniform except, possibly, the last. Thus credit-point value may be interpreted as functionally dependent upon percentage value. This function is integral and does not admit proper fractional credit-point values.

The systems, class (3), are such that, to successive percentage intervals, from 0% to 100%, are assigned, respectively, decreasing index values. The following is an example in class (3):

(e)
A - Excellent	90% to 100%	-	1 (Credit-index)
B - Good	80% to 90%	-	2 (Credit-index)
C - Fair	70% to 80%	-	3 (Credit-index)
D - Poor (but passing)	60% to 70%	-	4 (Credit-index)
E - Failure	50% to 60%	-	5 (Credit-index)
F - Failure	40% to 50%	-	6 (Credit-index)
Z - Failure	0% to 40%	-	7 (Credit-index)

This and all other examples of class (3), when mathematically interpreted, result in step-functions, constant in stretches, with uniform down-jumps at the close of the stretches all of which, after the first, are uniform except, possibly, the last. Thus credit-index values may be interpreted as functionally dependent upon percentage value. This function is integral and does not admit proper fractional credit-index values.

Thus from the preceding classification and description, the functions representing classes (2) and (3), respectively, do not lend themselves directly to interpolation between integral grade-point and index values in the same system, nor is it possible to transform continuously from one step-system to another throughout the complete interval of existence of the grading system. The functions of classes (2) and (3) do not possess unique inverses.

In the present paper, we replace the up-step systems of class (2) by approximating functions which are continuous and increasing in the strict sense throughout the whole range of definition of the grading system; and we replace the down-step systems of class (3) by approximating functions which are continuous and decreasing in the strict sense throughout the whole range of definition of the grading system. Such functions lend themselves readily to interpolation and to transformation.

In section 2 of this paper we discuss finite distribution functions. This discussion is followed by the determination of the interpolation function of the general up-step grading system in section 3. As examples of section 3, we study in section 4 the grading systems with points $\{-2,-1,0,1,2,3,(4)\}$ and points $\{0,1,2,3,4,(5)\}$. In section 5, we investigate the down-step systems as an immediate derivation from the up-step systems. We conclude the paper with section 6 where we show how to transform any given dilated step-system and also any contracted one into one whose units are the basic units. At the end of the paper are the graphs and a list of references indicated by corresponding superscripts throughout the paper.

2. Finite Distribution Functions.[2] A function $F(x)$ is called a finite distribution function, if

(1) it is constant in stretches and has only a finite number of discontinuities
(2) it increases (in the wide sense) from 0 to 1, so that $F(-\infty)=0$, $F(\infty)=1$,
(3) $F(x)=\frac{1}{2}\{F(x-0)+F(x+0)\}$ for all x.

Let us represent the most elementary function of this type, namely, the Heaviside Unit Function, $\frac{1}{2}(1+\operatorname{sgn} x)$, by $E(x)$. This function is 1, when $x \geq 0$ and is 0, when $x < 0$, with the single jump at $x=0$. See Figure 1. We now write $E_\xi(x)=E(x-\xi)$. Then by composition,

$$(1) \quad F(x)=1+\sum_{\nu=1}^{n} h_\nu E_{t_\nu}(x)$$

is the general finite distribution function with jumps h_ν at points t_ν, such that $t_1<t_2<\cdots<t_n$, $\Sigma h_\nu=h-1$, where $F(-\infty)$ is the summit level of the function, and $F(\infty)=1$ is the base level of the function with respect to the x - axis. $F(x)=1$ is monotonically increasing with a finite number, n, of discontinuities and has the value 1 for $x<t_1$ and $h(h>1)$, for $x \geq t_n$. See Figure 2 for the general finite distribution function, where $t_2-t_1=t_3-t_2=t_4-t_3=\ldots=t_n-t_{n-1}=t$ and $h_1=h_2=h_3=\ldots=h_n=n$.
This specialization of the general finite distribution function gives us the general function for the

(1) For references, see the last page.
(2) Ibid.

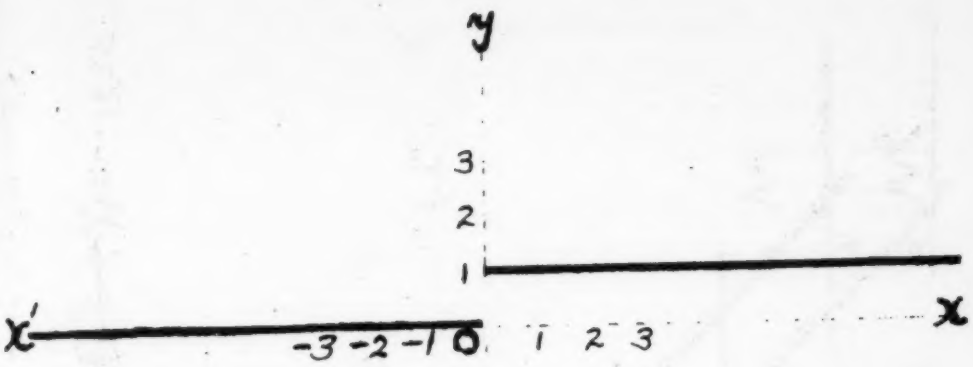

Figure 1.

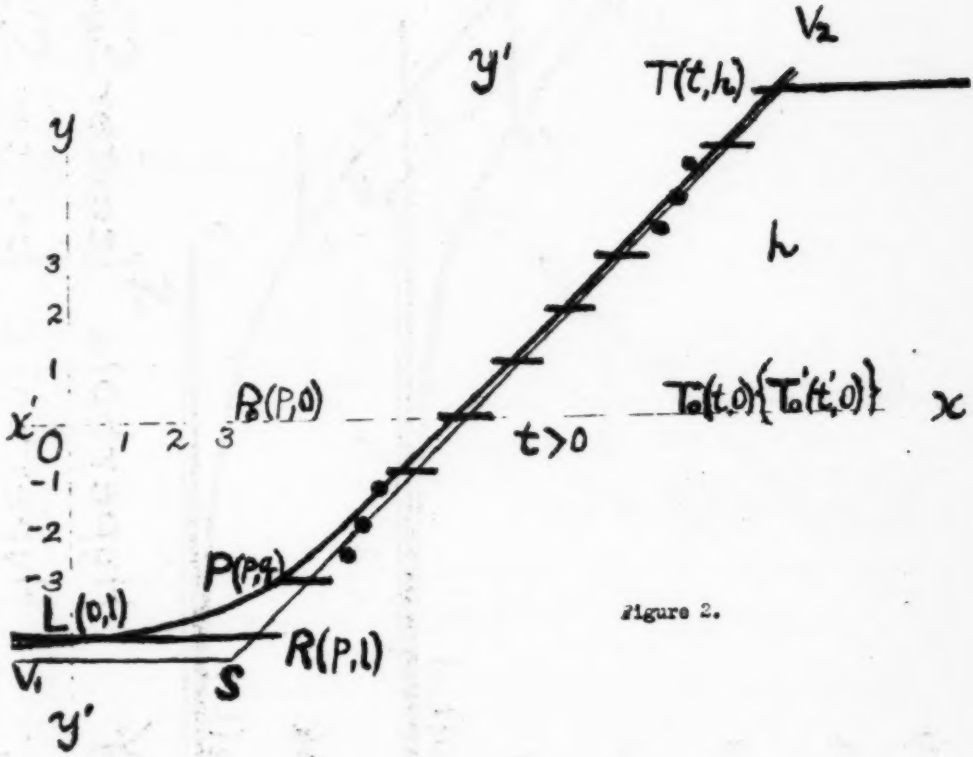

Figure 2.

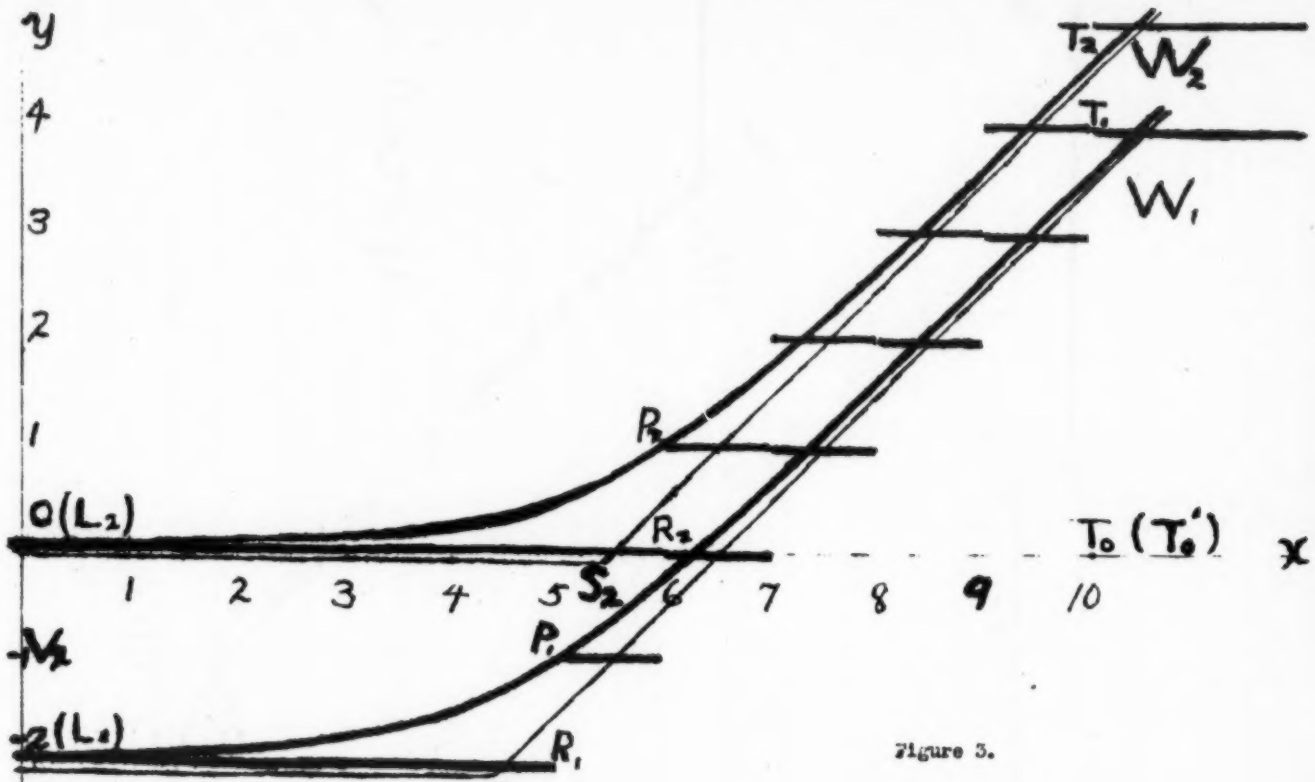

Figure 3.

Hyperbola (center S_1): $(y+2.125)(x-y-6.5)=-.5625$

Hyperbola (center S_2): $(y+.1)(x-y-5.5)=-.55$

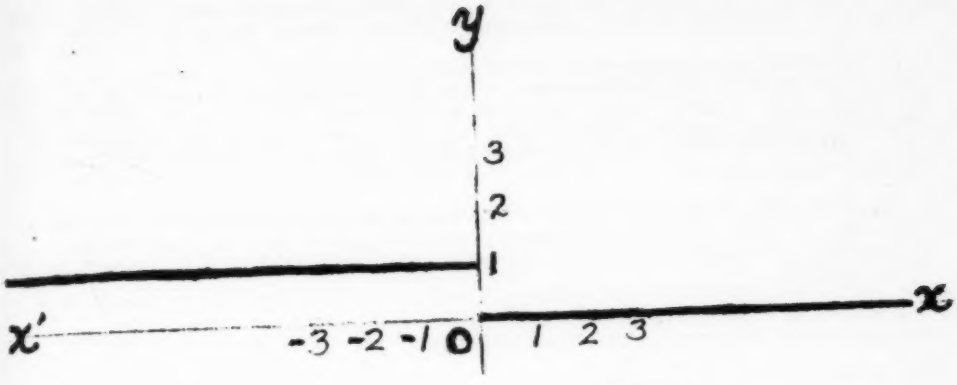

Figure 4.

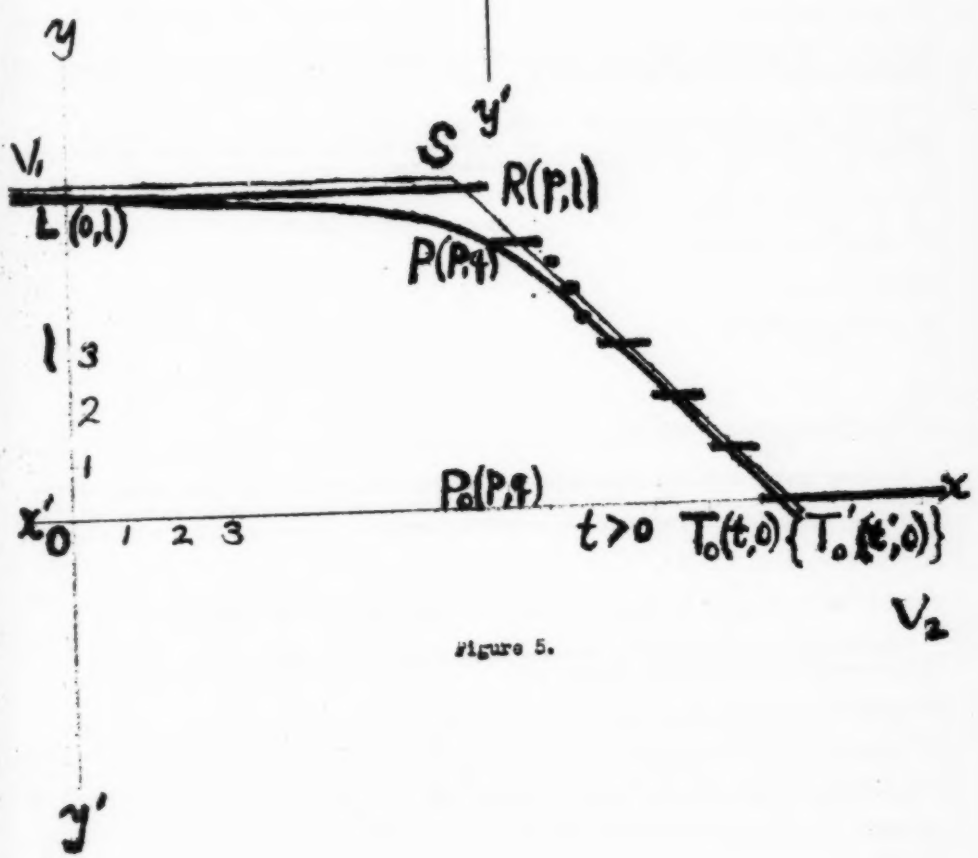

Figure 5.

grading systems of class (2), i.e., the up-step grading systems, the grade scale of length t, originating at 0 and terminating at T_0, such that $0 \leq t-t < \tau$, where $t = p + n\tau$.

3. The Interpolation Function of the General Up-Step Grading System. As we have said, the general function for the up-step grading systems is constant in stretches and possesses a finite number of discontinuities. It admits integral grade-point values but does not interpolate fractional ones. The function does not possess a unique inverse. To every x there corresponds one and only one $F(x)$, but, to every $F(x)$, there correspond infinitely many x's. $F(x)$ does not lend itself directly to transformation.

Let us define (1) the line $y=A$, where A is a constant later to be determined, as the trend line of base failure, (2) the locus of the mid-points of the $n(n>1)$ jumps to the right of the base stretch, as the trend line of decreasing failure and increasing success, and (3) the line $y=h$ as the 'summit level of success'.

The equation of the locus in (2) of the above definitions is $x-y=B$, where $B=t'-h+\frac{1}{2}$ Thus we see that the composite trend has the equation

(2) $(y-A)(x-y-B)=0.$

Write

(3) $(y-A)(x-y-B)=C,$

where C is an arbitrary constant. Equation (3) represents the family of hyperbolas whose asymptotes are the intersecting straight lines $y-A=0$ and $x-y-B=0$, given by (2).

We now determine the two constants A and C, so that the hyperbola passes through (o,l), the initial point of the grade range and (p,q), the top point of the first jump. The conditions that equation (3) be satisfied by (o,l) and (p,q), respectively, are

(4) $-(l+B)A+C=-(l+B)l,$

(5) $(p-q-B)A+C=(p-q-B)q,$

whence, we have

(6) $A=\dfrac{(p-q-B)q+(B+1)l}{p-q+l}$

and

(7) $C=\dfrac{(B+1)(p-q-B)q-(p-q-B)(B+1)l}{p-q+l}$

The upper branch of the curve represented by equation (3) together with equations (6) and (7) is continuous and increasing in the strict sense. We therefore define the interpolation function of the general up-step grading system to be the curvilinear trend

(8) $(y-A)(x-y-B)=C, \quad l \leq y \leq h,$

where A and C are given by equations (6) and (7), and $B=t'-h+\frac{1}{2}$. See Figure 2.[4]

Consider any two up-step grading systems $S_1[L_1, R_1, P_1, n_1, T_1]$ and $S\ I, R, P, n, T$ Their interpolation functions are, respectively,

(9) $(y_1-A_1)(x_1-y_1-B_1)=C_1, \quad l_1 \leq y_1 \leq h_1,$

(10) $(y_2-A_2)(x_2-y_2-B_2)=C_2, \quad l_2 \leq y_2 \leq h_2.$

From (9) and (10), we have, when $x_1=x_2$, the relation

(3) Ibid.
(4) Ibid.

(11) $\frac{C_1}{y_1-A_1} + y_1+B_1 = \frac{C_2}{y_2-A_2} + y_2+B_2.$

Thus, by means of (11), we compute grade-points in S_2 corresponding to given grade-points in S_1 and vice versa.

The step-system (1) with t and n we shall call the nominal grading system, while the continuous system (8) we shall call the effective grading system.

For convenience in computation, equation (8) may be put in the parametric form

(12) $x = e^{ky}+A+Ce^{-ky}+B$, $y = e^{ky}+A$, $l^{\frac{1}{2}}y^{\frac{1}{2}}h$.

Thus corresponding values of x and y may be computed from a table of exponential functions.

The general conic in the plane may be expressed in the form

(13) $ax^2+2hxy+by^2+2gx+2fy+c = 0.$

The relations

(14) $\Sigma = a+b$, $I = ab-h^2$, $\Delta = abc+2fgh-af^2-bg^2-ch^2$

are invariants of the conic with respect to translation and rotation, while the relation $J = ab+bc+ca-f^2-g^2-h^2$ is an invariant of the conic with respect to rotation only. Now, putting (8) in the form (13), we have

(15) $(0)x^2+2(\frac{1}{2})xy+(-1)y^2+2(-\frac{A}{2})x+2(\frac{A-B}{2})y+(AB-C) = 0.$

Thus, for (15), $\Sigma = -1$, $I = -\frac{1}{4}$, and $\Delta = \frac{C}{4}$.

The squares of the semi-axes of the general conic in the plane are given as the roots r^2 of the equation

(16) $(I^2)(r^2)^2 + (\Delta.\Sigma.I)(r^2) + \Delta^2 = 0.$ (5)

Hence, we have

(17) $r^2 = \frac{-\Delta\Sigma \pm \Delta\sqrt{\Sigma^2-4I}}{2I}$.

Therefore the squares of the semi-axes of (15) are given by

(18) $r^2 = 2C(1 \pm \sqrt{2})$

and the equation of the hyperbola referred to its own axes becomes

(19) $\frac{y^2}{2C(1+\sqrt{2})} + \frac{x^2}{2C(1-\sqrt{2})} = 1$, $C>0$;

$\frac{y_y^2}{2C(1-\sqrt{2})} + \frac{x^2}{3C(1+\sqrt{2})} = 1$, $C<0$.

4. An Example. In this section let us apply the result (11) of section 3 to the two systems given as examples (a) and (b) of the introduction. See Figure 3. Let $O\,T_0$ be divided into ten equal parts and take the length of a part as the unit length along both the x-axis and the y-axis, that is, the width of a uniform step and the height of a jump. A unit interval on the x-axis, represents ten per cent, while, on the y-axis, a unit interval represents one grade-point. These we shall call the basic units. We now determine the numerical values of the constants A , B , C of the effective systems corresponding to the nominal systems (a) and (b), respectively:

(a) $S_1\{-2,-1,0,1,2,3,(4)\}$

$B_1 = t'-h+\frac{1}{2}$

$= 10-4+\frac{1}{2}$

$= 6.5.$

$$A_1 = \frac{(p-q-B)q+(B+1)1}{p-q+1}$$

$$= \frac{(5-[-1]-6.5)(-1)+(6.5+[-2])(-2)}{5-[-1]+[-2]}$$

$$= -2.125.$$

$$C_1 = \frac{(B+1)(p-q-B)q-(p-q-B)(B+1)1}{p-q+1}$$

$$= \frac{(6.5+[-2])(5-[-1]-6.5)(-1)-(5-[-1]-6.5)(6.5+[2])(-2)}{5-[-1]+[-2]}$$

$$= -0.5625.$$

(b) $S_2\{0,1,2,3,4,(5)\}$

$B_2 = t'-h+\frac{1}{2}$

$= 10-5+\frac{1}{2}$

$= 5.5.$

$$A_2 = \frac{(p-q-B)q+(B+1)1}{p-q+1}$$

$$= \frac{(6-1-5.5)(1)+(5.5+0)(0)}{6-1+0}$$

$$= -0.1.$$

$$C_2 = \frac{(B+1)(p-q-B)q-(p-q-B)(B+1)1}{p-q+1}$$

$$= \frac{(5.5+0)(6-1-5.5)(1)-(6-1-5.5)(5.5+0)(0)}{6-1+0}$$

$$= -0.55.$$

Relation (11), for these systems (a) and (b), now becomes

$$(20)\quad \frac{-0.5625}{y_1+2.125}+y_1+6.500 = \frac{-0.5500}{y_2+0.1000}+y_2+5.500,$$

which reduces to

$$(21)\quad \frac{10y_2^2+56y_2}{10y_2+1} = \frac{8y_1^2+69y_1+106}{8y_1+17}.$$

Let us now put $y = 0.3000$ in (21). Then

$$\frac{10y_2^2+56y_2}{10y_2+1} = \frac{8(.09)+69(.3)+106}{8(.3)+17} = 6.671.$$

Hence we have the quadratic equation

$$(22)\quad 10y_2^2-10.71y_2-6.671 = 0,$$

whose upper solution is

$$(23)\quad y_2 = \frac{10.71+\sqrt{381.5}}{20} = 1.512.$$

The method just used for $y_1=0.3000$ may be used for any value of y_1 and thus obtain the corresponding value of y_2. However, the process is long and tedious. It is suggested that equations (12) be used in connection with a table of exponential functions.

5. The General Down-Step Grading System. In section 2 we defined $E(x) = \frac{1}{2}(1+\text{sgn}x)$. From the definition, it follows that $E(-x) = \frac{1}{2}(1-\text{sgn}x)$. See Figure 4. Let us write $E_\xi(-x) = E(\xi - x)$. The reversed general finite distribution function thus becomes

$$(24)\quad F(x) = 1 + \sum_{\nu=0}^{n-1} h_{n-\nu} E_{t_{n-\nu}}(-x).$$

It has jumps $h_{n-\nu}$ at points $t_{n-\nu}$, such that $t_n > t_{n-1} > t_{n-2} > \ldots > t_1$, $\Sigma h_{n-\nu} = 1-h$, where $F(x)=1$ is the summit level of the function and $F(x)=h$ is the base level of the function with respect to the x-axis. $F(x)$ is monotonically decreasing with a finite number n of discontinuities and has the value 1 for $x<p$ and $h(h<1)$, for $x \geq t$. See Figure 5 for the reversed general finite distribution function where $t_n - t_{n-1} = t_{n-1} - t_{n-2} = t_{n-2} - t_{n-3} = \ldots = t_2 - t_1 = T$, $h_n = h_{n-1} = h_{n-2} = \ldots h_1 = n=1$, $l=n$, and $h=0$. This is the general down-step grading system, class (3), mentioned in the introduction. It replaces point magnitudes of class (2) by the respective orders of magnitude. The two entities are complementary. Thus, to every down-step grading system there is a corresponding up-step grading system. If we call any point of the down-step system $(x\ y)$ and the corresponding point of the up-step system $(\bar{x}\ \bar{y})$, then, when $x=\bar{x}$, $y+\bar{y}=n$, and $\bar{y}=n-y$. Since $(\bar{x},\bar{y})$ must satisfy (8), the interpolation function of the general up-step grading system, we have

$$(25)\quad ([n-y]-A)(x-[n-y]-B)=C,\quad l \leq y \leq h,$$

which may be written

$$(26)\quad (y-[n-A])(x+y-[n+B]) = -C,\quad l \leq y \leq h.$$

Relation (26) represents the effective grading system corresponding to the nominal grading system with indices $\{n, n-1, n-2, \ldots, 3, 2, 1, (0)\}$. See Figure 5. The number (0) is assigned as the value of the down-step function corresponding to the right end-point of the grading system.

Thus we see from the analysis in this section that any down-step grading system may be investigated by studying first the complementary up-step system, determining the constants A, B, C of the system and then using relation (25) or (26).

6. The Dilated and Contracted Step-Functions. In section 4 we defined what we called the basic units. Here in section 6 we will briefly consider step-functions the width of whose step and height of whose jump are constant multiples of the basic units. Call (X,Y) any point of the dilated function, where the coordinates of points are given in dilated units. If (X,Y) in dilated units corresponds to (x,y) in basic units, then $x = \lambda X$, $y = \lambda Y$, where λ is a constant greater than unity. The interpolation function (8), in terms of dilated units, may be written

$$(27)\quad (Y-A')(X-Y-B') = C',\quad l' \leq Y \leq h'.$$

Thus, in terms of the basic units, (27) becomes

$$(28)\quad \frac{y}{\lambda}-\frac{A}{\lambda}\ \ \frac{x}{\lambda}-\frac{y}{\lambda}-\frac{B}{\lambda} = \frac{C}{\lambda},\quad \frac{l}{\lambda} \leq \frac{y}{\lambda} \leq \frac{h'}{\lambda},$$

or

$$(29)\quad (y-A)(x-y-B) = C\lambda,\quad l \leq y \leq h.$$

System (d) of the introduction is an example of a dilated step-system.

If λ be a constant greater than zero and less than unity, then (X,Y) represents any point of the function in contracted units. The step-function will then be called the contracted step-function. Write $\lambda\lambda^{-1} = 1$, where λ^{-1} is the inverse of λ. Then λ^{-1} is a constant greater than unity. Hence $X = \lambda^{-1}x$, $Y = \lambda^{-1}y$. The interpolation function, in basic units, becomes

$$(30)\quad (\lambda^{-1}y-\lambda^{-1}A)(\lambda^{-1}x-\lambda^{-1}y-\lambda^{-1}B) = \lambda^{-1}C,\ \lambda^{-1}l \leq \lambda^{-1}y \leq \lambda^{-1}h,$$

or

$$(31)\quad (y-A)(x-y-B) = C\lambda,\quad l \leq y \leq h,$$

which is identical in form with (29).

The case $\lambda=1$ merely gives $x=X$, $y=Y$, thus immediately carrying us back to (8), the original relationship.

Graphs

Figure 1. The origin does not belong to the graph of the up-step 'unit function'.

Figure 2. The right end-points of the first n stretch-intervals do not belong to the step-graph.

The dot triads are continuation signs indicating possible additional stretches and jumps. The number of stretches must be greater than or equal to 3 and the number of jumps must be greater than or equal to 2 and 1 less than the number of stretches.

If the right end-point of the nth stretch interval coincides with the end of the grade scale, call it $T_n(t,0)$. Otherwise call it $T_n'(t',0)$. In the formulas of the paper, t' may be replaced by t, as occasion demands.

V_1 and V_2 represent symbolically points at infinity for the hyperbola (center S).

Figure 3. The right end-points of the first n stretch-intervals do not belong to the step-graph.

The initial point of the grade scale is O(0,0). The terminal point of the grade scale is T (10,0).

V_1 and W_1 represent symbolically points at infinity for the hyperbola (center S_1) and V_2 and W_2 represent symbolically points at infinity for the hyperbola (center S_2).

Figure 4. The point (0,1) does not belong to the graph of the down-step 'unit function'.

Figure 5. The right end-points of the first n stretch-intervals do not belong to the step-graph.

The dot triad is a continuation sign indicating possible additional stretches and jumps. The number of stretches must be greater than or equal to 3, , and the number of jumps must be greater than or equal to 2 and 1 less than the number of stretches.

If the right end-point of the nth stretch-interval coincides with the end of the grade scale, call it T (t,0). Otherwise call it T (t ,0). In the formulas of the paper, t' may be replaced by t, as occasion demands.

V_1 and V_2 represent symbolically points at infinity for the hyperbola (center S).

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Due to the number of errors that occurred in the following paper as published in the March 1947 issue of the Journal of Experimental Education, it seemed desirable to reprint a corrected copy.

ON DETERMINING THREE DIMENSIONAL REGIONS OF SIGNIFICANCE*

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In dealing with the problem of testing certain linear hypotheses, Johnson and Neyman (16) introduced a new statistical concept, "the region of significance", which has had a number of applications principally in the field in which the technique was originally applied (1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 17, 21, 22).

As pointed out in (16 p -78), a region of significance is defined by the inequality $S_a^2 \leq f_\alpha \, S_r^2$

where f_α is the value of the likelihood criterion corresponding to a chosen level of significance, α, i.e., $\alpha = .01$, $\alpha = .05$, etc., and S_a^2 and S_r^2 are the absolute and relative minimum sum of squares, respectively, providing two optimum estimates of the population variance, σ^2, under the conditions prescribed by the properties of the region of significance. These properties are that for certain systems of values of two independent variables, x', y', the hypothesis, $H(x', y')$, should be rejected. This hypothesis in (16) referred to the difference between the best linear estimates of the means of two random samples of observational values. The hypothesis could refer to other statistical functions of observational data as well. The distinction between this type of hypothesis and the usual null hypothesis may be made as follows: The usual null hypothesis specifies some fixed set of parameter values estimated for the single system of values, say x_1, y_1, provided by the experimental data, and the process of testing the hypothesis consists in setting up a critical region for this specified set of values, x_1, y_1. If the experimental value, or sample point, falls in this critical region, the hypothesis $H(x_1, y_1)$ is rejected and the generalization usually obtains for the population for which the sample is presumably representative. The Johnson-Neyman technique distinguishes between the systems of values of x' and y' for which the hypothesis $H(x', y')$ should be rejected and the systems for which the hypothesis should be accepted. It thus becomes possible to specify the population in terms of the basic characteristics, x and y, for which a generalization is permissible. That is, the analysis shows first if there are values of x and y for which, say, the difference in means between two groups is significant. Should such values exist for the variables x, y, they are bounded by a conic section, i.e., an ellipse, parabola, or an hyperbola. Geometrically, then, for two independent variables, the "region of significance" is represented by a conic section. The section can be plotted and the hypothesis $H(x', y')$ represented by any point of this region should be rejected at the level of significance, α, chosen.

The method of setting up the region of significance for a variable null hypothesis is logically equivalent to setting up what might be called a "no confidence" region. That is, if, say, $H(x', y')$ is true then the probability is less than α, that if we draw a sample and determine the region of significance, say, R, the region R will contain the sample point. Alternatively, if every time a sample is drawn and the region R determined we make the statement "For no point, E, of R is $H(x', y')$ true" we may expect to be right about $100(1 - \alpha)$ per cent of the time. It should be pointed out, however, that if we draw only one sample, compute R, take a series of points, $x_1, y_1; x_2, y_2;$ ..... in R, and say "$H(x_1, y_1)$ is false, $H(x_2, y_2)$ is false," ..... etc., we cannot say that $100(1 - \alpha)$ per cent of these statements will be correct. If an unusual sample had been drawn, we might well be wrong every time.

In this paper the concept of the "region of significance" has been extended to three dimensions. The derivations can, of course, be extended to any number of independent variables. However, the presentation is limited to three independent variables both as an illustration and to obtain specific useful results. The statistical formulation and solution of the problem are presented first, followed by the practical illustration in a research problem including the contours used to represent the region of significance in three dimensional space.

*This is one of a number of studies on modern principles of experimental design and statistical analysis. For the research grant to finance these studies, grateful acknowledgment is given to the Graduate School, the University of Minnesota.

Let y represent the value of the experimental character and let u, v, and h represent the values of three other characters of individuals which are assumed to influence both the experimental character, y, and its reaction on conditions say, A and B, whose influence on y is under investigation. The variables u, v, h play the role of independent variables and the experimental character y that of a dependent variable. The values of the experimental character for individuals subject to the conditions A and B are denoted by y' and y'', respectively.

Our basic assumptions may be expressed by saying that the population means of y' and y'' of individuals with fixed values of u, v, and h are some functions (not necessarily the same) of these values u, v, and h, i.e.,

(1) $\mathcal{E}(y') = f_1(u, v, h)$ $\qquad$ $\mathcal{E}(y'') = f_2(u, v, h)$

Our purpose is --

(1) To test the hypotheses, say, H (u', v', h') that for some particular system of fixed values $u = u'$, $v = v'$, and $h = h'$ the two means are equal, or

(2) $f_1(u', v', h') = f_2(u', v', h')$

This, if true, would indicate that the difference in conditions A and B does not affect the average value of the experimental character of individuals in which $u = u'$, $v = v'$, $h = h'$).

The functions f_1 and f_2 are chosen according to the conditions of the particular problem, with the single restriction that both functions f_1 and f_2 must be linear with respect to the unknown parameters they involve.

Here it will be assumed that the polynomials are of the first degree. Thus we write

(3) $\mathcal{E}(y') = a_1 + b_1 u + c_1 v + d_1 h$

(4) $\mathcal{E}(y'') = a_2 + b_2 u + c_2 v + d_2 h$

(5) The coefficients $a_1, b_1, c_1, d_1, a_2, b_2, c_2, d_2$ will play the role of these parameters.

The hypothesis, H (u', v', h') to test will be described by one equation

(6) $\theta(u', v', h') = a_1 - a_2 + (b_1 - b_2) u' + (c_1 - c_2) v' + (d_1 - d_2) h' = 0.$

It should be pointed out that it is assumed that, for any fixed values of u, v, h, the distributions of y' and y'' are normal about means (3) and (4) with the same, though unknown variance.

(2) To discriminate between such systems of values, u', v', h' for which the hypothesis $H(u', v', h')$ should be rejected and those for which the hypothesis $H(u', v', h')$ will be accepted. Each system of u', v', and h', (or each hypothesis $H(u', v', h')$) will be represented by a point lying in space with coordinates u', v', h'. Generally it will be possible to specify a region, which is called the region of significance, such that the hypothesis, $H(u', v', h')$ represented by any point of this region should be rejected. This discrimination is made here on the basis of the criterion of likelihood proposed by Neyman and Pearson (19). If we let

(7) $S^2 = \Sigma_1 (y - a_1 - b_1 u - c_1 v - d_1 h)^2 + \Sigma_2 (y - a_2 - b_2 u - c_2 v - d_2 h)^2$ where Σ_1 and Σ_2 represent the summations for the samples subject to the conditions A and B respectively, we can define the criterion of likelihood in the following manner.

(8) $$U = \frac{S_a^2}{S_r^2}$$

where S_a^2 is the minimum value that (7) may assume for any values of (5) and where S_r^2 is the least value that (7) may adopt under the condition that the relation (6) is satisfied. Among others, Kolodziejczyk (18) has demonstrated that S_a^2 is independent of S_b^2 where

(9) $$S_b^2 = S_r^2 - S_a^2$$

He has further shown that if random samples are drawn from the same normal population, the probability distribution of U will be

$$(10) \qquad p(U) = \frac{1}{B\left(\frac{N-S}{2}, \frac{r}{2}\right)} U^{\frac{N-S}{2}} (1-U)^{\frac{r}{2}-1}$$

where S represents the total number of parameters required for specifying the class of admissible hypothes, r represents the number of these specified by the hypothesis tested and N represents the total number of observations. In this case s is eight and r is one. The value of U_ε for which

$$(11) \qquad \int_0^{U_\varepsilon} p(U)\, dU = \varepsilon$$

can be obtained by the use of the Incomplete Beta Function table (20). Kolodziejczyk (18) has also shown that if one desires only those percentage points tabled by Fisher (7) in his table of z that the quantities

$$(12) \qquad \frac{S_a^2}{N-S} \quad \text{and} \quad \frac{S_b^2}{r}$$

are those which the latter author considers two independent estimates of the common variance. After one has determined the value of U, say U_o, for a particular set of observational data and the hypothesis to be tested, he then compares it to the value of U_ε obtained from either of the tables mentioned above. If the value of $U_o \leq U_\varepsilon$ the probability of rejecting the hypothesis when it correctly described the conditions under which the observations were made, is less than or equal to ε.

In order to determine the appropriate values that (5) will assume in S_a^2, we consider for the moment that they are continuous variables and differentiate (7) partially with respect to each of these variables. When each of these partial derivatives is set equal to zero we have the familiar systems.

$$(13) \qquad \begin{cases} a_1 n_1 + b_1 \Sigma_1 u + c_1 \Sigma_1 v + d_1 \Sigma_1 h = \Sigma_1 y \\ a_1 \Sigma_1 u + b_1 \Sigma_1 u^2 + c_1 \Sigma_1 uv + d_1 \Sigma_1 uh = \Sigma_1 uy \\ a_1 \Sigma_1 v + b_1 \Sigma_1 vu + c_1 \Sigma_1 v^2 + d_1 \Sigma_1 vh = \Sigma_1 vy \\ a_1 \Sigma_1 h + b_1 \Sigma_1 hu + c_1 \Sigma_1 hv + d_1 \Sigma_1 h^2 = \Sigma_1 hy \end{cases}$$

$$(14) \qquad \begin{cases} a_2 n_2 + b_2 \Sigma_2 u + c_2 \Sigma_2 v + d_2 \Sigma_2 h = \Sigma_2 y \\ a_2 \Sigma_2 u + b_2 \Sigma_2 u^2 + c_2 \Sigma_2 uv + d_2 \Sigma_2 uh = \Sigma_2 uy \\ a_2 \Sigma_2 v + b_2 \Sigma_2 vu + c_2 \Sigma_2 v^2 + d_2 \Sigma_2 vh = \Sigma_2 vy \\ a_2 \Sigma_2 h + b_2 \Sigma_2 hu + c_2 \Sigma_2 hv + d_2 \Sigma_2 h^2 = \Sigma_2 hy \end{cases}$$

Denote the values of (5) determined by solving (13) and (14) by

$$(15) \qquad a_1^\circ,\ b_1^\circ,\ c_1^\circ,\ d_1^\circ,\ a_2^\circ,\ b_2^\circ,\ c_2^\circ,\ d_2^\circ,$$

in terms of these we have

$$(16) \qquad \begin{aligned} S_a^2 = {} & \Sigma_1 y^2 - a_1^\circ \Sigma_1 y - b_1^\circ \Sigma_1 uy - c_1^\circ \Sigma_1 vy - d_1^\circ \Sigma_1 hy \\ & + \Sigma_2 y^2 - a_2^\circ \Sigma_2 y - b_2^\circ \Sigma_2 uy - c_2^\circ \Sigma_2 vy - d_2^\circ \Sigma_2 hy \end{aligned}$$

In order to determine the values that (5) will assume in S_r^2, that is, under the condition that relation (6) is satisfied, we minimize

$$(17) \qquad \phi = S^2 - 2\alpha\left\{(a_1 + b_1 u' + c_1 v' + d_1 h') - (a_2 + b_2 u' + c_2 v' + d_2 h')\right\}$$

where α is an undetermined multiplier, the value of which we shall determine later. If we regard u', v', and h' as fixed and (5) as continuous variables, we then differentiate ϕ partially with respect to each of these variables. When each of these partial derivatives is set equal to zero we obtain the following systems.

$$(18) \qquad \begin{cases} a_1 n_1 + b_1 \Sigma_1 u + c_1 \Sigma_1 v + d_1 \Sigma_1 h = \Sigma_1 y + \alpha \\ a_1 \Sigma_1 u + b_1 \Sigma_1 u^2 + c_1 \Sigma_1 uv + d_1 \Sigma_1 uh = \Sigma_1 uy + \alpha u' \\ a_1 \Sigma_1 v + b_1 \Sigma_1 vu + c_1 \Sigma_1 v^2 + d_1 \Sigma_1 vh = \Sigma_1 vy + \alpha v' \\ a_1 \Sigma_1 h + b_1 \Sigma_1 hu + c_1 \Sigma_1 hv + d_1 \Sigma_1 h^2 = \Sigma_1 hy + \alpha h' \end{cases}$$

$$(19) \qquad \begin{cases} a_2 n_2 + b_2 \Sigma_2 u + c_2 \Sigma_2 v + d_2 \Sigma_2 h = \Sigma_2 y - \alpha \\ a_2 \Sigma_2 u + b_2 \Sigma_2 u^2 + c_2 \Sigma_2 uv + d_2 \Sigma_2 uh = \Sigma_2 uy - \alpha u' \\ a_2 \Sigma_2 v + b_2 \Sigma_2 vu + c_2 \Sigma_2 v^2 + d_2 \Sigma_2 vh = \Sigma_2 vy - \alpha v' \\ a_2 \Sigma_2 h + b_2 \Sigma_2 hu + c_2 \Sigma_2 hv + d_2 \Sigma_2 h^2 = \Sigma_2 hy - \alpha h' \end{cases}$$

Denote the values of (5) determined by solving (18) and (19) by

(20) $a_1', b_1', c_1', d_1', a_2', b_2', c_2', d_2'$

Then S_r^2 may be written as

(21) $$S_r^2 = \Sigma_1 y^2 - a_1'\Sigma_1 y - b_1'\Sigma_1 uy - c_1'\Sigma_1 vy - d_1'\Sigma_1 hy + \Sigma_2 y^2 - a_2'\Sigma_2 y - b_2'\Sigma_2 uy - c_2'\Sigma_2 vy - d_2'\Sigma_2 hy$$

The relation between S_α^2 and S_r^2 can be obtained in terms of determinants as shown in the following paragraphs. Let the determinant

(22) $$D = \begin{vmatrix} \Sigma_1 y^2 & \Sigma_1 y & \Sigma_1 uy & \Sigma_1 vy & \Sigma_1 hy \\ \Sigma_1 y & n_1 & \Sigma_1 u & \Sigma_1 v & \Sigma_1 h \\ \Sigma_1 uy & \Sigma_1 u & \Sigma_1 u^2 & \Sigma_1 uv & \Sigma_1 uh \\ \Sigma_1 vy & \Sigma_1 v & \Sigma_1 vu & \Sigma_1 v^2 & \Sigma_1 vh \\ \Sigma_1 hy & \Sigma_1 h & \Sigma_1 hu & \Sigma_1 hv & \Sigma_1 h^2 \end{vmatrix}$$

(23) and let D' denote the determinant with the similar elements except that n_1 is replaced by n_2 and the sums are taken for the sample subject to the conditions B. Let D_{ij} and D'_{ij} represent the cofactors of the j-th element in the i-th row for the determinants (22) and (23). Then

(24) $$a_1^\circ = -\frac{D_{12}}{D_{11}}\ ;\quad b_1^\circ = -\frac{D_{13}}{D_{11}}\ ;\quad c_1^\circ = -\frac{D_{14}}{D_{11}}\ ;\quad d_1^\circ = -\frac{D_{15}}{D_{11}}$$

(25) $$a_2^\circ = -\frac{D'_{12}}{D'_{11}}\ ;\quad b_2^\circ = -\frac{D'_{13}}{D'_{11}}\ ;\quad c_2^\circ = -\frac{D'_{14}}{D'_{11}}\ ;\quad d_2^\circ = -\frac{D'_{15}}{D'_{11}}$$

Substituting these values in (16) gives

(26) $$S_\alpha^2 = \frac{1}{D_{11}}\left\{D_{11}\Sigma_1 y^2 + D_{12}\Sigma_1 y + D_{13}\Sigma_1 uy + D_{14}\Sigma_1 vy + D_{15}\Sigma_1 hy\right\} + \frac{1}{D'_{11}}\left\{D'_{11}\Sigma_2 y^2 + D'_{12}\Sigma_2 y + D'_{13}\Sigma_2 uy + D'_{14}\Sigma_2 vy + D'_{15}\Sigma_2 hy\right\}$$

which is equivalent to

(27) $$S_\alpha^2 = \frac{D}{D_{11}} + \frac{D'}{D'_{11}}$$

Let

(28) $$R = \begin{vmatrix} 0 & 1 & u' & v' & h' \\ 1 & n_1 & \Sigma_1 u & \Sigma_1 v & \Sigma_1 h \\ u' & \Sigma_1 u & \Sigma_1 u^2 & \Sigma_1 uv & \Sigma_1 uh \\ v' & \Sigma_1 v & \Sigma_1 vu & \Sigma_1 v^2 & \Sigma_1 vh \\ h' & \Sigma_1 h & \Sigma_1 hu & \Sigma_1 hv & \Sigma_1 h^2 \end{vmatrix}$$

(29) and let R' represent the determinant whose elements are the corresponding sums for the sample subject to the conditions B. Let R_{ij} and R'_{ij} represent the cofactors of the j-th element in the i-th row for the determinants (28) and (29). Comparison with (22) and (23) reveals that $R_{11} = D_{11}$ and $R'_{11} = D'_{11}$. In terms of these cofactors the solution of (18) and (19) may be written as

(30) $$a_1' = -\frac{D_{12}+\alpha R_{12}}{D_{11}}\ ;\ b_1' = -\frac{D_{13}+\alpha R_{13}}{D_{11}}\ ;\ c_1' = -\frac{D_{14}+\alpha R_{14}}{D_{11}}\ ;\ d_1' = -\frac{D_{15}+\alpha R_{15}}{D_{11}}$$

(31) $$a_2' = -\frac{D'_{12}+\alpha R'_{12}}{D'_{11}}\ ;\ b_2' = -\frac{D'_{13}+\alpha R'_{13}}{D'_{11}}\ ;\ c_2' = -\frac{D'_{14}+\alpha R'_{14}}{D'_{11}}\ ;\ d_2' = -\frac{D'_{15}+\alpha R'_{15}}{D'_{11}}$$

Comparison with (24) and (25) reveals that

(32) $$a_1' = a_1^\circ - \frac{\alpha R_{12}}{D_{11}}\ ;\ b_1' = b_1^\circ - \frac{\alpha R_{13}}{D_{11}}\ ;\ c_1' = c_1^\circ - \frac{\alpha R_{14}}{D_{11}}\ ;\ d_1' = d_1^\circ - \frac{\alpha R_{15}}{D_{11}}$$

(33) $$a_2' = a_2^\circ - \frac{\alpha R'_{12}}{D'_{11}}\ ;\ b_2' = b_2^\circ - \frac{\alpha R'_{13}}{D'_{11}}\ ;\ c_2' = c_2^\circ - \frac{\alpha R'_{14}}{D'_{11}}\ ;\ d_2' = d_2^\circ - \frac{\alpha R'_{15}}{D'_{11}}$$

Substituting these values in (21) gives

(34) $$S_r^2 = S_\alpha^2 + \frac{\alpha}{D_{11}}\left\{R_{12}\Sigma_1 y + R_{13}\Sigma_1 uy + R_{14}\Sigma_1 vy + R_{15}\Sigma_1 hy\right\} - \frac{\alpha}{D'_{11}}\left\{R'_{12}\Sigma_2 y + R'_{13}\Sigma_2 uy + R'_{14}\Sigma_2 vy + R'_{15}\Sigma_2 hy\right\}$$

It can be shown that

(35) $$R_{12}\Sigma_1 y + R_{13}\Sigma_1 uy + R_{14}\Sigma_1 vy + R_{15}\Sigma_1 hy = D_{12} + D_{13}u' + D_{14}v' + D_{15}h'$$

in the following manner. Denote the cofactor $D_{11} = R_{11}$ by A and let A_{ij} represent the cofactor of the j-th element in the i-th row of this new determinant. Then

(36) $R_{12} = - A_{11} - u'A_{21} - v'A_{31} - h'A_{41}$

(37) $R_{13} = - A_{12} - u'A_{22} - v'A_{32} - h'A_{42}$

(38) $R_{14} = - A_{13} - u'A_{23} - v'A_{33} - h'A_{43}$

(39) $R_{15} = - A_{14} - u'A_{24} - v'A_{34} - h'A_{44}$

If we multiply (36) by Σ_1 y, (37) by Σ_1 uy, (38) by Σ_1 vy, (39) by Σ_1 hy and add we obtain the relation (35) since $A_{ij} = A_{ji}$. Similarly it can be shown that

(40) $R'_{11}\Sigma_2 y + R'_{12}\Sigma_2 uy + R'_{13}\Sigma_2 vy + R'_{14}\Sigma_2 hy = D'_{12} + D'_{13}u' + D'_{14}v' + D'_{15}h'$

Making use of the relations (35) and (40), (34) yields

(41) $S_r^2 = S_a^2 + \frac{\alpha}{D_{11}}\left\{D_{12} + D_{13}u' + D_{14}v' + D_{15}h'\right\} - \frac{\alpha}{D'_{11}}\left\{D'_{12} + D'_{13}u' + D'_{14}v' + D'_{15}h'\right\}$

If we consider the relations (24) and (25), (41) may be written as

(42) $S_r^2 = S_a^2 - \alpha\left\{(a_1^\circ + b_1^\circ u' + c_1^\circ v' + d_1^\circ h') - (a_2^\circ + b_2^\circ u' + c_2^\circ v' + d_2^\circ h')\right\}$

In order to evaluate α explicitly in terms of previously defined quantities, we notice from (32) that

(43) $(a_1' - a_1^\circ) + (b_1' - b_1^\circ)u' + (c_1' - c_1^\circ)v' + (d_1' - d_1^\circ)h' =$
$= -\frac{\alpha}{R_{11}}\left[R_{12} + R_{13}u' + R_{14}v' + R_{15}h'\right]$ or $-\frac{\alpha}{R_{11}}R$

and from (33) that

(44) $(a_2' - a_2^\circ) + (b_2' - b_2^\circ)u' + (c_2' - c_2^\circ)v' + (d_2' - d_2^\circ)h' =$
$= \frac{\alpha}{R'_{11}}\left[R'_{12} + R'_{13}u' + R'_{14}v' + R'_{15}h'\right]$ or $\frac{\alpha}{R'_{11}}R'$

(45) If we denote $-\frac{R}{R_{11}}$ by P and $-\frac{R'}{R'_{11}}$ by Q we have

(46) $\alpha(P + Q) = (a_1' - a_1^\circ) + (b_1' - b_1^\circ)u' + (c_1' - c_1^\circ)v' + (d_1' - d_1^\circ)h'$
$- (a_2' - a_2^\circ) - (b_2' - b_2^\circ)u' - (c_2' - c_2^\circ)v' - (d_2' - d_2^\circ)h'$

(47) $\alpha(P+Q) = (a_1' - a_1^\circ) + (b_1' - b_1^\circ)u' + (c_1' - c_1^\circ)v' + (d_1' - d_1^\circ)h'$
$-(a_2' - a_2^\circ) - (b_2' - b_2^\circ)u' - (c_2' - c_2^\circ)v' - (d_2' - d_2^\circ)h'$

Since the first line of the right member of (47) was assumed, by the hypothesis, to be zero,

(48) $\alpha = -\frac{(a_1^\circ - a_2^\circ) + (b_1^\circ - b_2^\circ)u' + (c_1^\circ - c_2^\circ)v' + (d_1^\circ - d_2^\circ)h'}{P + Q}$

If we denote the numerator of this fraction by D(u', v', h') (48) becomes

(49) $\alpha = -\frac{D(u', v', h')}{P + Q}$

Likewise (42) may be written as

(50) $S_r^2 = S_a^2 - \alpha\left\{D(u', v', h')\right\}$

Eliminating α from (49) and (50), we have

(51) $S_r^2 = S_a^2 + \frac{\left\{D(u', v', h')\right\}^2}{P + Q}$

The region of significance is defined as that portion of u, v, h space for which the following inequality is satisfied.

(52) $\frac{S_a^2}{S_r^2} \geqq U_\epsilon$ or $U_\epsilon S_r^2 - S_a^2 \geqq 0$

This region is bounded by the surface

(53) $U_\epsilon S_r^2 - S_a^2 = 0$

which becomes

(54) $\frac{U_\epsilon}{1 - U_\epsilon}\left\{D(u', v', h')\right\}^2 - (P + Q)S_a^2 = 0$

if we consider the relations (51) and (53). If the constant $\frac{U_\epsilon}{1 - U_\epsilon}$ is denoted by w, (54) may be written as

$$(55)\quad w\left\{D(u', v', h')\right\}^2 - (P + Q)S_w^2 = 0$$

In practice the solution of system (13) can be carried on simultaneously with that of (18). This process yields the following relations

$$(56)\quad \begin{aligned} a_i' &= a_i^\circ + \alpha(k_{i1} + l_{i1}u' + m_{i1}v' + n_{i1}h') \\ b_i' &= b_i^\circ + \alpha(k_{i2} + l_{i2}u' + m_{i2}v' + n_{i2}h') \\ c_i' &= c_i^\circ + \alpha(k_{i3} + l_{i3}u' + m_{i3}v' + n_{i3}h') \\ d_i' &= d_i^\circ + \alpha(k_{i4} + l_{i4}u' + m_{i4}v' + n_{i4}h') \end{aligned}$$

Likewise the simultaneous solution of (14) and (19) yields the following relations

$$(57)\quad \begin{aligned} a_2' &= a_2^\circ - \alpha(k_{2i} + l_{2i}u' + m_{2i}v' + n_{2i}h_i) \\ b_2' &= b_2^\circ - \alpha(k_{22} + l_{22}u' + m_{22}v' + n_{22}h') \\ c_2' &= c_2^\circ - \alpha(k_{23} + l_{23}u' + m_{23}v' + n_{23}h') \\ d_2' &= d_2^\circ - \alpha(k_{24} + l_{24}u' + m_{24}v' + n_{24}h') \end{aligned}$$

where the k's, l's, m's, and n's are constants.

From (56) we have that

$$(a_i' - a_i^\circ) + (b_i' - b_i^\circ)u' + (c_i' - c_i^\circ)v' + (d_i' - d_i^\circ)h'$$

$$(58)\quad = \alpha\left\{\begin{aligned} &(k_{i1} + l_{i1}u' + m_{i1}v' + n_{i1}h') \\ &+ (k_{i2} + l_{i2}u' + m_{i2}v' + n_{i2}h')u' \\ &+ (k_{i3} + l_{i3}u' + m_{i3}v' + n_{i3}h')v' \\ &+ (k_{i4} + l_{i4}u' + m_{i4}v' + n_{i4}h')h' \end{aligned}\right.$$

The quantity in the left member of (58) was previously (43) defined as αP. Hence (56) and (58) give a means for computing P without the use of determinants. Similarly, from (57)

$$(a_2' - a_2^\circ) + (b_2' - b_2^\circ)u' + (c_2' - c_2^\circ)v' + (d_2' - d_2^\circ)h'$$

$$(59)\quad = -\alpha\left\{\begin{aligned} &(k_{2i} + l_{2i}u' + m_{2i}v' + n_{2i}h') \\ &+ (k_{22} + l_{22}u' + m_{22}v' + n_{22}h')u' \\ &+ (k_{23} + l_{23}u' + m_{23}v' + n_{23}h')v' \\ &+ (k_{24} + l_{24}u' + m_{24}v' + n_{24}h')h' \end{aligned}\right.$$

According to (44) the quantity in the left member of (59) was defined as $-\alpha Q$

Part II: Practical Application

An application of the preceding formulation is given below. The investigation was directed at determining the difference in achievement between two groups of college students undergoing instruction in two different types of courses in general physics. There are three criteria for determining the relative abilities of the two groups, each of which has been shown to bear a relationship to achievement, (1) score on the American Council on Education Psychological Examination, (2) proficiency in elementary mathematics, (3) honor-point ratio. The measure of achievement consisted of the score on the Mechanics section of the Cooperative Physics Test for College Students. The data were collected during the academic year of 1940-41 in the University of Minnesota. The foregoing scores were obtained for 111 students in the first course, Physics 1, and for 257 in the other, Physics 7.

Table I contains the summary statistics for these two groups while Table II contains the quantities (15) which gives (7) its absolute minimum value. Substituting these values (15) in (16) gives S_a^2 = 13,258.38. Table III contains the values of the constants, the k's, l's, m's and n's of formulas (56) and (57). From these P and Q are computed according to (58) and (59), then multiplied by S_a^2 to give

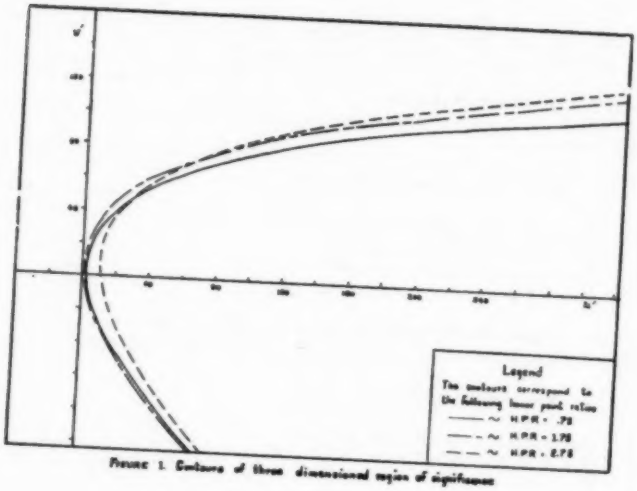

FIGURE 1. Contours of three dimensional region of significance

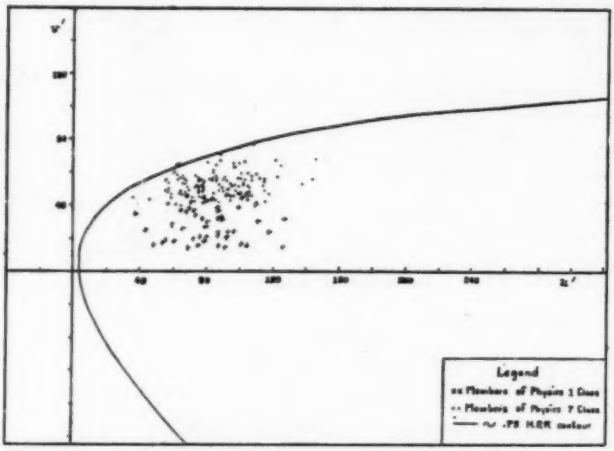

FIGURE 2. Plane section of three dimensional region of significance corresponding to lower panel ratios from .28 - 1.27

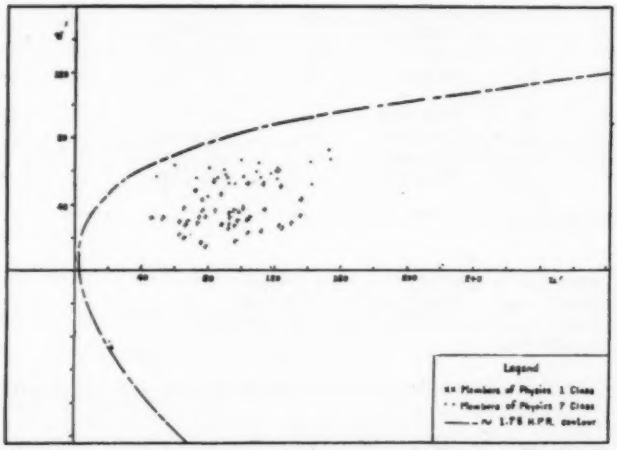

FIGURE 3. Plane section of three dimensional region of significance corresponding to lower panel ratios from 1.28 - 2.27

Table I
Summary Statistics for Physics 1 and Physics 7

	Physics 1	Physics 7
N - the number of students	111	257
Σ y achievement test score	1,324	6,783
Σy^2	19,862	194,001
Σ u psychological test score	9,728	23,746
Σ v mathematics test score	3,450	14,411
Σ h honor point ratio	1,286	3,261
Σu^2	905,694	2,338,412
Σv^2	118,846	823,945
Σh^2	20,084	53,417
Σuy	118,635	645,402
Σvy	44,200	386,261
Σhy	17,532	92,843
Σuv	307,220	1,349,410
Σuh	117,560	319,746
Σvh	42,408	191,223

Table II
Regression Coefficients

$a_1^\circ = 2.01554247$	$a_2^\circ = 10.26490910$
$b_1^\circ = .00103309$	$b_2^\circ = .06771814$
$c_1^\circ = .19246053$	$c_2^\circ = .08561873$
$d_1^\circ = .33144215$	$d_2^\circ = .39956522$

Table III

Inverse Matrices*

$k_{11} = +.20122307$	$l_{11} = -.00146961$	$m_{11} = -.00208607$	$n_{11} = +.00012250$
$k_{12} = -.00146961$	$l_{12} = +.00002085$	$m_{12} = -.00000514$	$n_{12} = -.00001711$
$k_{13} = -.00208607$	$l_{13} = -.00000514$	$m_{13} = +.00009678$	$n_{13} = -.00004069$
$k_{14} = +.00012250$	$l_{14} = -.00001711$	$m_{14} = -.00004069$	$n_{14} = +.00022802$
$k_{21} = +.26071669$	$l_{21} = -.00043274$	$m_{21} = -.00448355$	$n_{21} = +.00272429$
$k_{22} = -.00043274$	$l_{22} = +.00000881$	$m_{22} = -.00000444$	$n_{22} = -.00001040$
$k_{23} = -.00448355$	$l_{23} = -.00000444$	$m_{23} = +.00010173$	$n_{23} = -.00006389$
$k_{24} = +.00272429$	$l_{24} = -.00001040$	$m_{24} = -.00006389$	$n_{24} = +.00014339$

*See formulas (56) and (57)

$$(60)\quad S_a^2\ (P+Q) = .39323725\ u'^2 + 2.63185711\ v'^2 + 4.92434901\ h'^2 - .25399077\ u'v' - .72960070\ u'h' - 2.77303937\ v'h' - 50.44400724\ u' - 174.20505274\ v' + 75.48770951\ h' + 6124.57287519$$

Next, the value of $D(u', v', h')$ is determined according to the numerator of the right member of (48). This is found to be

$$(61)\quad D(u', v', h') = -8.2493666 - .066850\ u' + .1068418\ v' - .0681230\ h'$$

Hence

$$(62)\quad \left[D(u', v', h')\right]^2 = .00446892\ u'^2 + .01141517\ v'^2 + .00464074\ h'^2 - .01428475\ u'v' + .00910805\ u'h' - .01455677\ v'h' + 1.10294031\ u' - 1.76275435\ v' + 1.12394320\ h' + 68.05204930$$

In this case* the 5% level of significance is used for determining the constant w used in equation (55) whose locus is the surface bounding the "region of significance". By interpolation in Johnson and Neyman's Table (16) $\mathcal{U}$ (5%) of formula (11) is found to be .9893 and w = 93.047. We are now in a position to write explicitly the equation of the boundary surface. If we represent the left hand member of (55) by ψ (u′, v′, h′), this yields

$$\begin{aligned}(63)\quad \psi\ (u', v', h') = {} & .02258235\ u'^2 - 1.56970979\ v'^2 - 4.49254208\ h'^2 \\ & - 1.07516236\ u'v' + 1.57707743\ u'h' + 1.41857559\ v'h' \\ & + 153.06929333\ u' + 10.18604408\ v' + 29.09183342\ h' \\ & + 207.46612811\end{aligned}$$

Dividing (63) by the coefficient of u'^2 yields the following equation of the surface

$$\begin{aligned}(64)\quad & u'^2 - 69.510472\ v'^2 - 198.940416\ h'^2 - 47.610740\ u'v' + 69.836726\ u'h' \\ & + 62.817891\ v'h' + 6778.2711\ u' + 451.062179\ v' + 1288.2553\ h' \\ & + 9,187.0921 = 0\end{aligned}$$

The center of this region is found to be

$$-32.176574,\quad +83.53885,\quad -276.9091$$

The equation of the surface referred to its center as origin is

$$\begin{aligned}(65)\quad & u'^2 - 69.510472\ v'^2 - 198.940416\ h'^2 - 47.610740\ u'v' + 69.836726\ u'h' \\ & + 62.817891\ v'h' - 931,180.6048 = 0\end{aligned}$$

The method used here to represent this three-dimensional "region of significance" is to plot contours at several representative "levels" of the variable h which in this case is ten times the honor point ratio. The first contour plotted corresponds to h′ = 40 which is 7.823426 when referred to the original origin and hence represents an approximate honor point ratio of .78. The equation of this contour is:

$$(66)\quad u'^2 - 69.510472\ v'^2 - 47.610740\ u'v' + 2,793.4690\ u' + 2,512.7156\ v' - 1,259,085.2608 = 0$$

This equation is translated to its center as origin, where the center is - 105.5941, 54.23736. Then the equation of the contour is

$$(67)\quad u''^2 - 69.510472\ v''^2 - 47.610740\ u''v'' - 1,338,431 = 0$$

Next the axes are rotated through the angle whose tangent is λ in order to eliminate the u″v″term.* That is: the equation of the new u′ axis is $u = \lambda\ u''$ and the new v′axis is $v' = -\frac{1}{\lambda}\ u''$ where λ is the positive root of

$$(68)\quad h\lambda^2 + (a-b)\ \lambda - h = 0$$

where a, b and 2h represent the coefficients of u''^2, v''^2 and u″v″, respectively. In this case $\lambda = 3.267958$. If A and B are used to represent the coefficients of u^2 and v^2 respectively when referred to these rotated axes, the following relations hold:**

$$(69)\quad A + B = a + b$$

$$(70)\quad A\ B = ab - h^2$$

From these we find A = - 76.79494 and B = 8.28447 so the equation of this contour becomes

$$(71)\quad -76.79494\ u^2 + 8.28448\ v^2 - 1,338,431 = 0$$

The locus of this equation is shown in solid black in Figure 1. Contours corresponding to honor point ratios of 2.78 and 1.78 are plotted in dashes of uniform length for the former and in alternating long and short dashes for the latter. The center of the latter is - 131.9926, 67.7967 while that of the former is - 158.3921, 81.3560. The value of λ is the same for each of these as in the preceding case. The equations of these two contours when referred to the rotated axes are:

*Although this choice of the level of significance is entirely arbitrary on the part of the investigator, in any specific example the locus of (55) may be imaginary. In this instance S_r^2 was computed according to formula (21) and found to be 13,400 so that (8) yielded the value .989.

**See plane analytic geometry text such as Fine and Thompson (8) for this manner of carrying out a rotation of axes.

(72) $-76.79494\,u^2 + 8.28448\,v^2 - 1{,}825{,}895 = 0$

(73) $-76.794947\,u^2 + 8.28448\,v^2 - 1{,}552{,}509 = 0$

respectively.

A plane section cutting the three-dimensioned region at the level where the honor point ratio is .78 is shown in Figure 2. The dots represent individuals in the Physics 7 class who had honor point ratios between .28 and 1.27 and the small x's represent members of the Physics 1 class with the same range of honor point ratios. The interpretation to be given to this plane section of the three dimensioned region of significance is that for all systems of values of u', v', and h' falling in this region the data would be sufficient for the rejection of the hypothesis, $H(u', v', h')$ stating that $\Theta(u', v', h') = 0$. Specifically, in this case, the mean final scores of the Physics 7 class on the Mechanics section of the Cooperative Test for College Students may be expected to be higher than the mean scores of the Physics 1 class for all systems of values of psychological test scores (u'), mathematical test scores (v'), and honor point ratios (h') (in this case with an average honor point ratio of .78, for individual values ranging from .28 to 1.27) falling within the region of significance.

Figure 3 is a similar plane section corresponding to an honor point ratio of 1.78 with observational values in the range from 1.28 to 2.27. The interpretation is similar to that for Figure 2. Only 24 cases occupied positions above the plane section depicted in Figure 3 and 31 were below the section shown in Figure 2. Corresponding figures for this small number of cases are not reproduced here.

The three dimensional region of significance, or conicoid, may be an ellipsoid, a paraboloid, or an hyperboloid. In the interesting case of the hyperboloid, we reject the hypothesis, $H(u', v', h')$ stating that $\Theta(u', v', h') = 0$ in favor of the alternative hypothesis, sometimes assuming that $\Theta(u', v', h')$ is positive and sometimes that it is negative in accordance with the sign of $D(u', v', h')$, that is, the region of significance would consist of two parts determining values of u', v', h' for which alternatively the one or the other of the two groups under comparison may be said to be superior with respect to the criterion of comparison used.

It should be pointed out that the method developed here while applied to a problem in educational psychology could likely find a number of useful applications in science, particularly in agriculture, in biology, and in industry.

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